New Vanguard

OSPREY PUBLISHING

Siege Weapons of the Far East (2)

AD 960–1644

Stephen Turnbull • Illustrated by Wayne Reynolds

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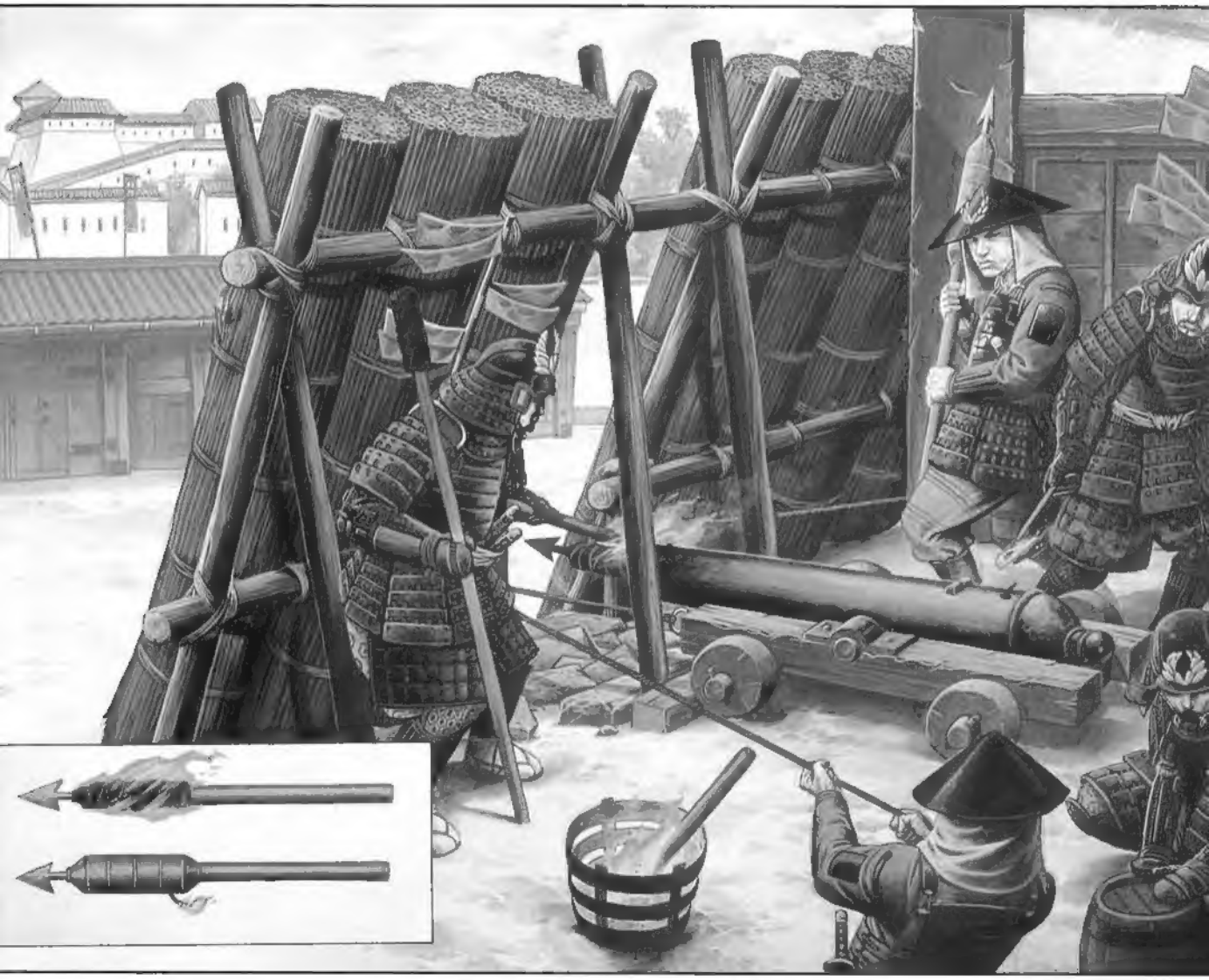

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Author's Dedication

To my sister-in-law, Shelagh Turnbull

Editor's note

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SIEGE WEAPONS OF THE FAR EAST (2) AD 960–1644

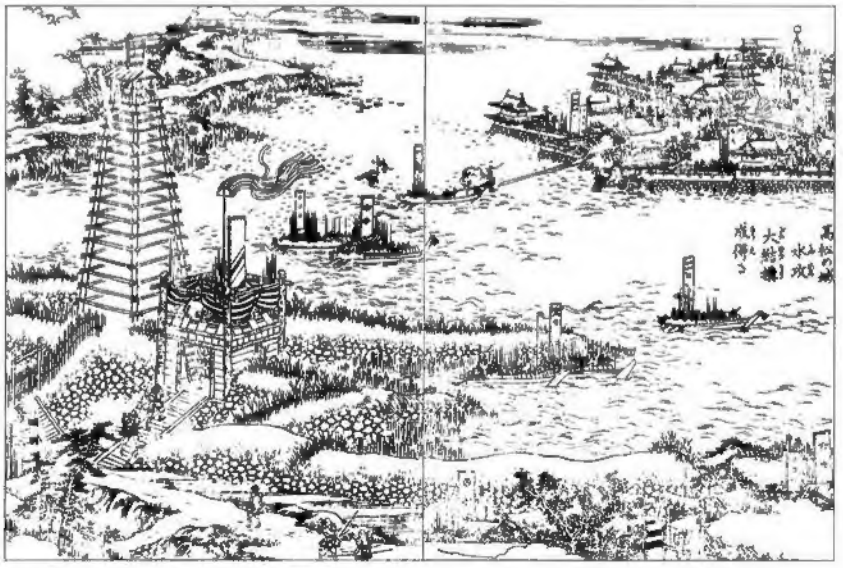
INTRODUCTION

As Volume 1 showed, China provided the rest of the world with numerous siege weapons from ancient times onwards. The traction trebuchet, for example, which originated in China, was taken to the West, and then returned to China as the counterweight trebuchet. Because of this 'Chinese connection', a Chinese siege engineer would have felt perfectly at home attacking Acre in 1291 or even Malta in 1565, where he would have recognised the familiar fire lances and been impressed by the enormous power of the Turkish siege guns.

We now turn to the great leap forward in siege warfare, and indeed in all warfare, that came about after the discovery of gunpowder, the substance that was China's greatest gift to the world of war. In works dealing with European warfare, the discussion of gunpowder as an explosive tends to concentrate on the introduction of the metal-barrelled cannon (another technological first for China), but the study of Chinese cannon has to be preceded by an examination of the gunpowder devices that came before them. The Chinese had been using gunpowder in its low-nitrate, incendiary form for at least a century before the world's first printed formula appeared in the *Wu Jing Zong Yao* of 1044, and it was this early type of gunpowder that was used in the incendiary devices and gas bombs described in Volume 1.

This volume begins with the explosive projectiles designed to be fired from non-gunpowder artillery, such as trebuchets, and then goes on to describe cannon. As in Volume 1, the examples chosen for the former topic are drawn from the time of the Song dynasty. However, as early cannon had only a limited impact on siege warfare, the illustrations for the latter theme will be taken from the last century of the Ming dynasty, when rocket launchers, mortars and European cannon literally exploded on to the Far Eastern scene. The final topic to be studied concerns the machines used for assaulting, observing, un-

A typical Japanese static siege tower at the siege of Takamatsu in 1582.



dermining and defending fortified places. Here we will have to backtrack considerably on the historical narrative set by the discussions of artillery in order to illustrate adequately the vast spectrum of Chinese innovation and its dissemination that took place over nearly two thousand years of military history.

The acknowledgements for this volume include the same individuals and institutions mentioned in Volume 1, with additional thanks to the Chesungdang on Hansando island, Korea; Kumamoto Castle Museum; the Tokugawa Art Museum, Nagoya; the Needham Institute, Cambridge; Fort Nelson; and the Museum of Historical Artillery in Turin.

SIEGE WARFARE IN THE FAR EAST AD 960–1644

The fourteenth century was a time of immense change in the Far East. New dynasties of emperors in China, kings in Korea and shoguns in Japan all came into being to the accompaniment of extensive siege warfare during those 100 years. There was also considerable technological development in the field of siege weapons. Metal-barrelled cannon, rare in 1300, were commonplace by 1400, and would eventually change the practice of siege warfare altogether.

China

The Mongol Yuan dynasty had achieved supreme power by utilising the best siege weapons and techniques that they had learned in China from the Song and the Jin, or had imported from the West during their long campaigns in distant lands. The Yuan also became the first rulers in history to make use of metal-barrelled cannon, which appeared in

The Great Wall of China, the Ming's outstanding contribution to defensive architecture, which was not enough to save them from defeat by the Manchus. Cannon were mounted on the Great Wall at the end of the Ming dynasty. (Picture by William Lindesday)

Chinese sieges decades before similar weapons were employed in Europe. But even cannon were not sufficient to save the Yuan from 'losing the mandate of Heaven'. A rebel army captured Nanjing in 1356 and, with this as their base, began a campaign to overthrow the Mongol dynasty. Siege warfare was changing rapidly. At the siege of Shaoxing in 1358–59 there were few catapults, but any lack in this regard was compensated for by the use of cannon. The rebels took Beijing in 1368, and in that same year their leader proclaimed himself the first emperor of the Ming dynasty.

The Ming made many contributions to siege warfare during their long hegemony, not the least of which was the creation of much of that amazing defensive structure known today as the Great Wall of China. In a sequence of ramparts and towers that snaked across the landscape in a way so familiar from modern photographs, the Great Wall made a profound statement about the Ming and what divided them from the barbarians outside. It is also during the Ming dynasty that we see European cannon in action in China for the first time. Yet neither modern cannon nor the world's longest line of fortifications could save the Ming from eventually losing their mandate to rule in favour of the Qing, or Manchu, dynasty.

The Manchus, originally called Jurchens, were the same tribes whose Jin dynasty had made their own contribution to siege weaponry by introducing iron-cased bombs in 1221. In 1616 their leader, Nurhachi, took the title of emperor of the Later Jin dynasty, and two years later openly attacked the Ming, capturing part of Liaodong. Following Nurhachi's death in battle in 1626, his son Abahai led expeditions against the Ming and broke through the passes in the Great Wall on several occasions between 1629 and 1638. In 1636, he proclaimed the Qing dynasty, and was able to take Beijing in 1644 largely because the commander of Shanhaiguan invited him and his army inside the Wall to help against the attacks of a Chinese rebel, Li Zicheng. It was actually this Li who brought about the fall of the Ming, and was then himself defeated by Dorgon, Abahai's brother.

Namhansansong, the great mountain castle south of Seoul which provided a temporary royal refuge during the Manchu invasion of Korea in 1635. It is like a miniature version of the Great Wall of China, with strong gates and solid walls.

Korea

In the same way that the Mongol dynasty of China gave way to the Ming, so the Koryo dynasty of Korea, which had reigned during the ruin of their country by the Mongols, were supplanted in 1392 by the Choson, or Yi, dynasty of kings, who were to rule Korea until 1910. Successive Korean monarchs made some outstanding contributions to military technology that are sadly little known in the West. These included the establishment

of a fine navy armed with excellent cannon, two innovations that were developed to combat the depredations of Japanese pirates. Cannon also provided the means for defending castle walls, yet Korea lagged behind in terms of castle construction. Her simple fortresses crumbled before the onslaught of the Japanese invasion in 1592, a tragedy that also exposed the scandalous weakness in her armed forces.

When the Manchus threatened China, Korea stood by the Ming, and suffered her own Manchu invasion as a consequence, but by then Korean fortification techniques had greatly improved. The newly completed fortress of Namhansansong, near Seoul, which looked like a miniature version of the Great Wall of China, held out for a while during the winter of 1635, but the Korean king was eventually forced to surrender.

Japan

Compared to the peaceful years of the thirteenth century, the fourteenth century in Japan was very much an age of war, during which Japan experienced its own dynastic change, with the establishment of the Ashikaga shogunate. Their power was soon challenged and, following the devastating Onin War in the mid-fifteenth century, Japan split into a country of rival *daimyo* (warlords), and did not become united again until the triumph of Toyotomi Hideyoshi in 1591.

Despite its pirate fleets being on the receiving end of Korean naval cannon from the fourteenth century onwards, Japan remained backward in matters of artillery compared to China and Korea. Her methods of castle construction were, however, superior in many aspects. From the mid-sixteenth century onwards, the traditional *yamashiro* (mountain castle) had evolved into a system of interlocking baileys laboriously carved out of the hillsides. These sculpted mounds then received a cladding of cyclopean yet mathematically precise stone blocks, and, in their final form, began to sport the keeps and gateways that were to become universal in Japan early in the seventeenth century. Yet these massive fortresses, totally unlike the modest Korean *sansong* (mountain castle) or the conceptually different Great Wall of China, were neither defended nor attacked primarily by catapults or siege cannon, but by thousands of infantrymen firing volleys of arquebus bullets to clear an enemy line prior to an assault.

This profound difference in attitudes to siege warfare was put to the test during the last decade of the sixteenth century, when the three military cultures of China, Korea and Japan met in war for the first time in a millennium and a half. The Korean War began in 1592 with the invasion of Korea by Toyotomi Hideyoshi, and the following year a Ming army crossed the Yalu to help expel the invading

The walls of Iga Ueno, showing the developed form of typical Japanese defences, whereby excavated and shaped hillsides or artificial mounds were clad with stone, thus giving the mathematically precise slopes characteristic of Japanese castles.

The Uto tower of Kumamoto, the castle built by Kato Kiyomasa after his experience of Chinese siege warfare. This shows the final form of Japanese defensive architecture whereby tower keeps were raised on top of the massive stone-clad mounds. The tower is provided with concealed 'machicolations' for dropping stones.

forces. During the war's numerous sieges, Chinese assault vehicles, wheeled ladders and mines were used by both sides as the Japanese rapidly learned the techniques for dealing with the unfamiliar situation of the fortified town. But their traditional neglect of, and contempt for, siege weapons was to be vividly illustrated by their surprise at being attacked by rockets and iron-cased exploding bombs fired from sophisticated Korean mortars. The Chinese, on the other hand, used their long expertise in siege warfare to good effect, and the Japanese finally withdrew from the mainland in 1598, with nothing to show for seven years of war. However, the conflict laid waste to Korea and gravely damaged the resources of Ming China, thus leaving both countries seriously weakened when they faced the Manchu onslaught mentioned above.

The Korean experience was an important military lesson for the Japanese, and huge castles began to be built, designed on the Chinese model to withstand long sieges. One outstanding example was Kumamoto, built by Kato Kiyomasa, a general who had suffered personally during the Chinese siege of Ulsan in the winter of 1597–98. So strong was Kumamoto that, when it was finally put to the test during the Satsuma Rebellion of 1877, it successfully withstood a siege by an army that possessed modern firearms.

The centuries of peace that Kumamoto enjoyed subsequent to its creation were typical for most of Japan after the last great siege of Osaka castle in 1615 had set the seal on the 'Tokugawa Peace'. Few rebellions disturbed the Tokugawa hegemony over the next 250 years, so that siege warfare atrophied through lack of use, as did much of Japanese military knowledge.

EXPLODING BOMBS

Soft-cased Exploding Bombs

In Volume 1, we discussed the use of gunpowder as an aid to combustion and as a component in smoke bombs. The introduction of the *pi li pao* (thunderclap bomb or thunderclap fireball) with its casing of stiffened paper indicates a progression to the use of gunpowder primarily as an explosive material. The name implies that the noise and shock of the explosion would cause alarm to an enemy's soldiers and horses even if it did them no other damage, but the inclusion of small sharp objects within the gunpowder mixture anticipated the later development of the iron-cased fragmentation bomb. A detailed description is found in the *Wu Jing Zong Yao* of 1044:

'The thunderclap bomb contains a length of two or three internodal sections of dry bamboo with a diameter of 1.5 inches. There must be no cracks, and the septa are

to be retained to avoid any leakage. Thirty pieces of thin broken porcelain the size of iron coins are mixed with three or four pounds of gunpowder, and packed around the bamboo tube. The tube is wrapped within the ball, but with about an inch or two protruding at each end. A gunpowder mixture is then applied all over the outer surface of the ball.'

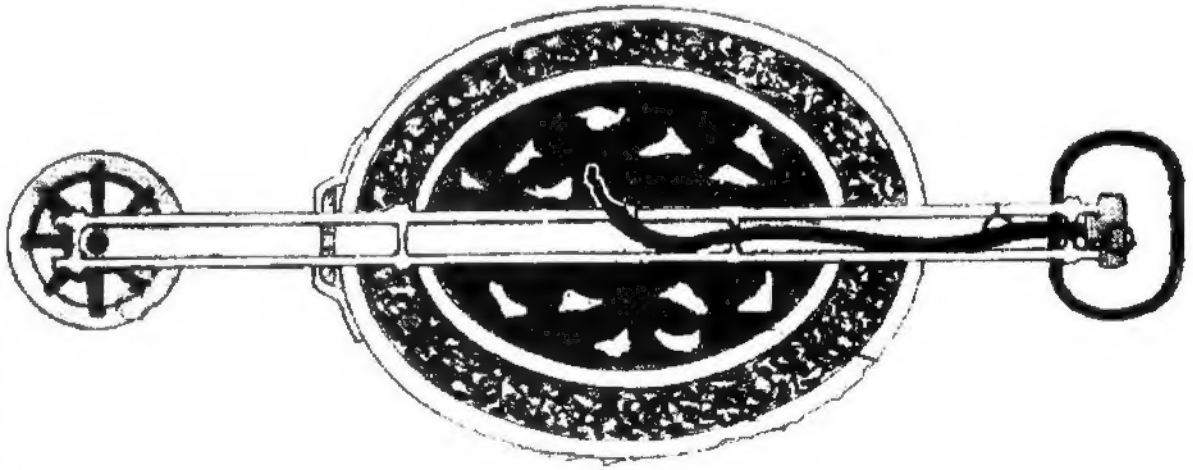
The covering of the inner ball is likely to have been many layers of paper. The outer layer of gunpowder was of the incendiary type we have encountered before, mixed with some kind of gum to hold it in place, and, like the examples noted earlier, it was the whole of this burning outer surface that acted as the 'fuse' for the subsequent explosion. It was ignited by a red-hot iron brand.

The one problem with the above description concerns the amount of gunpowder, because another source speaks of 30 pounds rather than three, but this may simply refer to the larger version of the bomb that had a separate fuse conducted into the explosive mixture via the bamboo tube. This was the type used in Japan during the fifteenth century. Contemporary illustrations of them show that they were large enough to require a pulling handle and wheel added to opposite ends of the protruding bamboo.

Thunderclap bombs were used by the Song when they defended Kaifeng against the Jin in 1126. This action is very interesting, because one of the Song commanders was reluctant to use the considerable range of siege weapons at his disposal:

'Cai Mou gave orders to all the officers and soldiers that [even] when the Jin troops came near the city, the trebuchets and crossbows were not to be used, and anyone who did so would be beaten; whereupon our men were very angry. I myself then took over the command, and ordered them to shoot off any such artillery as they should see fit, and those who attained their targets best were well rewarded. At night the thunderclap bombs were used, hitting the lines of the enemy well, and throwing them into great confusion. Many fled, howling with fright.'

The Song nonetheless lost this encounter and their city of Kaifeng; but in 1161, as the dynasty of the Southern Song, they hit back against the Jin



A sectional drawing of the larger Japanese version of the thunderclap bomb as used during the Onin War. It has a handle and wheel for easier transport, and a fuse that goes into the explosive mixture via the bamboo core. They were thrown from traction trebuchets.

at the battle of Caishi, when the northerners were trying to cross the Yangtze. On this occasion lime was incorporated into the Song thunderclap bombs, with the outer 'fuse' timed to cause an explosion as the falling weapon approached the surface of the river:

'Then all of a sudden a thunderclap bomb was let off. It was made with paper and filled with lime and sulphur. [Launched from trebuchets] these thunderclap bombs came dropping down from the air, and upon meeting the water exploded with a noise like thunder, the sulphur bursting into flames. The carton case rebounded and broke, scattering the lime to form a smoky fog which blinded the eyes of men and horses so they could see nothing.'

The best description of the use of thunderclap bombs as a defensive siege weapon concerns the Jin siege of the Southern Song city of Xiangyang in 1207:

'The artillerists held up their torches and shouted, while the soldiers on the city walls also shouted and beat drums while the thunderclap bombs were shot off. The wretches were terrified and quite lost their senses, men and horses running away as fast as they could.'

The bee swarm bomb, an ingenious variation of soft-cased bomb that was filled with iron caltrops and small firecrackers that stuck to the victim's clothing. It was thrown by hand using a rope handle.

Thunderclap bombs were used to repel another attack the following day, and then the Southern Song took the fight to the besiegers' camp:

'On the evening of the 25th day, taking advantage of the rain and overcast sky, the commander urgently sent the officers Zhang Fu and Hao Yan to prepare boats large and small, more than 30 in number, to carry 1,000 crossbowmen, 500 trident spearmen, and 100 drummers, together with thunderclap bombs and gunpowder arrows. They took cover by the riverbank below the enemy's encampment . Then at the stroke of a drum the crossbowmen let fly a volley, and immediately following all this the drums sounded and all the crossbows were fired. Simultaneously the thunderclap bombs and the fire arrows were sent into the enemy's camp. How many were killed and wounded in this attack could not be known, but men and horses were thrown into confusion and trampled upon each other.'

Soft-cased thunderclap bombs continued to be used and developed well into the time of the Ming, in spite of the introduction of iron-cased bombs. They could also be used as signalling devices. During Khubilai Khan's Java campaign in 1293, the sound of a 'pao' was the signal used to co-ordinate the start of a battle. Another variation was the 'bee swarm bomb', which was effectively a large anti-personnel grenade thrown by hand. It was fitted with a rope handle so that it could be whirled round the head like a sling. A similar means of propulsion for grenades is known to have been used in Japan, particularly in naval warfare. The

construction of a Ming bee swarm bomb is given as follows:

'Bamboo strips are woven into the shape of a ball and pasted round with forty or fifty layers of thick paper, then dried in the sun. Afterwards it is wrapped up further in fifteen layers of oiled paper. Make an opening in it and fill it with two pounds of gunpowder, and half a pound of iron caltrops, putting in also several dozen "flying swallow poison fire gunpowder firecrackers" made of paper.'

The ten thousand enemies bomb in action. This simple soft-cased bomb consisted of gunpowder inside a clay pot protected within a wooden frame. It was designed to be merely dropped from a wall rather than being projected.

The commentary notes that as well as the damage caused by the explosion and the release of the caltrops, the 'flying swallows' stuck to their victims and burned them.

A larger and clumsier version of a soft-cased bomb bore a name that indicated that it was the match for 'ten thousand enemies'. The housing of the ten thousand enemies bomb was clay, and it was then enclosed in a cuboid wooden framework or wooden tub so that the missile did not break before its fuse detonated the explosive. The reason for this is that the ten thousand enemies was neither thrown by a rope sling nor projected from a trebuchet, but simply dropped over the battlements of a castle, and there is a well-known illustration showing how the resulting explosion could blow the besiegers to pieces. 'The force of the explosion spins the bomb round in all directions, but the city walls protect one's own men from its effects on that side, while the enemy's men and horses are not so fortunate,' says a passage dating from the end of the Ming dynasty. The continued use of this type of bomb even at that late date is supported by the account of a European visitor to China in 1585 who described seeing 'bombs of fire, full of old iron'.

The only account we have of thunderclap bombs in Japan concerns the exploding bombs thrown by traction trebuchets in 1468. They were of the larger variety mentioned at the beginning of this section. In a vivid description of their use during the Onin War, we are told that they resembled Chinese plums, a neat analogy for their ovoid shape, and that they 'destroyed armies by spreading fire within their ranks'. Similar bombs were probably used in Japan as late as in 1614 during the defence of Osaka castle.

Iron-cased Exploding Bombs

The introduction of exploding iron bombs represented a further step forward in Chinese military technology. Unlike the soft-cased thunderclap bombs, the *zhen tian lei* (thunder crash bombs or, more literally, heaven shaking thunder), killed people by the shattering of

their metal cases, and destroyed objects by the increased force of the explosion that is implied by the dramatic name.

The introduction of thunder crash bombs is credited to the Jin, and their first recorded use in war dates from the siege by the Jin of the Southern Song city of Qizhou in 1221. The list of siege weapons used at Qizhou by the besiegers was an eclectic mix of the primitive and the modern, ranging from Greek fire projectors and expendable birds carrying small incendiaries, to the new, exploding cast-iron bombs. They were shaped like a bottle gourd with a small opening, and were made from cast iron about two inches thick. The fragments produced when the bombs exploded caused great personal injury, and one Southern Song officer was blinded in an explosion that wounded half a dozen other men. The Southern Song's defensive armoury, although well stocked, contained nothing comparable, and was limited to the devices described earlier, such as 7,000 gunpowder arrows for firing from siege crossbows and 3,000 barbed fireballs fitted with hooks.

By this time in their history, the Jin were themselves under pressure from the advancing Mongols, who had taken Beijing from them in 1215. The year 1231 was to find the Jin besieged by a Mongol army in Hezhong and using iron bombs to defend themselves. This was the first time that these devices were referred to in the literature as thunder crash bombs. When the city fell, the Jin escaped along the Yellow River, and we are told that they fired thunder crash bombs at the Mongol fleet attempting to delay their progress, and broke through the cordon.

The following year of 1232 saw the celebrated siege of Kaifeng, the Jin capital, by the Mongols under the famous general Subadai, and once again thunder crash bombs were brought into action in a city's defence. The fuses were lit, the trebuchets released, and:

'.. there was a great explosion the noise whereof was like thunder, audible for more than a hundred li, and the vegetation was scorched and blasted by the heat over

This well-known illustration shows a Mongol thunder crash bomb, launched from a traction trebuchet, exploding in front of a mounted Japanese samurai in 1274. It is from the *Mongol Invasion Scroll*, which Takezaki Suenaga had painted to back up his claim for reward.

an area of more than half a mou. When hit, even iron armour was quite pierced through.'

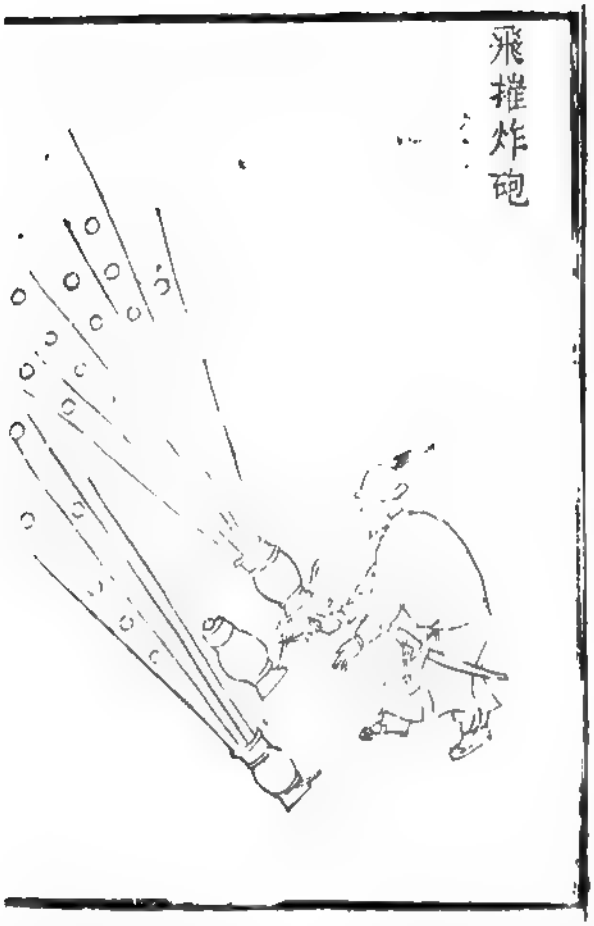
A separate account states that those who were not wounded by fragments were burned to death by the explosions, so the Mongols were forced to resort to desperate defensive measures as they approached the city walls:

'Therefore the Mongol soldiers made cowhide shields to cover their approach trenches and men beneath the walls, and dug as it were niches each large enough to contain a man, hoping that in this way the troops above would not be able to do anything about it. But someone suggested the technique of lowering the thunder crash bombs on iron chains. When these reached the trenches where the Mongol were making their dugouts, the bombs were set off, with the result that the cowhide and the attacking soldiers were all blown to bits, not even a trace being left behind.'

At this stage in their military development, the Mongols do not appear to have possessed anything similar to either thunderclap bombs or thunder crash bombs, and their trebuchet missiles were confined to large stones 'like half millstones'. But, having shown once again the willingness to embrace change that had led the Mongols to adopt siege crossbows and traction trebuchets, thunder crash bombs had entered their repertoire by the time they began the epic siege of Xiangyang in 1267. The Southern Song defenders had thunder crash bombs too – the defeat of the Jin by the Mongols had been an acute lesson to them – but there was a serious shortage of supply. Ten years earlier, an official had complained, in a memorandum about his own town's defences, that the Southern Song arsenal had once produced several thousand thunder crash bombs a month, but that they now had only 85 in stock, together with 95 fire arrows and 105 fire lances, 'which is not sufficient for a mere hundred men, let alone a thousand, to use against an attack by the (Mongol) barbarians'.

By 1267 Xiangyang appears to have been much better stocked, and one thunder crash bomb at least caused a named casualty when a certain Mongol officer called Liu Xianying led the attack up scaling ladders against Xiangyang's sister city of Fancheng across the river. A thunder crash bomb fired from a trebuchet exploded beside him, causing a serious wound in his left thigh. The next time that we hear a mention of this same Liu, his wound had healed and he was involved in a simultaneous attack on the walls of the city and on a fleet of Southern Song paddle ships bringing supplies along the river. This action is most interesting because the accounts of it confirm that the Mongols had thunder crash bombs of their own, 'which were thrown with great noise and with loud reports' so that on the Song ships 'they were up to the ankles in blood'. A further, and successful, provisioning operation was carried out later on in the siege, and this time the Southern Song ships were equipped with fire lances, siege crossbows and trebuchets shooting firebombs, but the use of thunder crash bombs was not recorded for this operation by either side.

Despite their power, thunder crash bombs were more effective as anti-personnel weapons than for battering down walls. Later during this siege, counterweight trebuchets were brought into action for the first



The first Chinese mortar, dating from the Ming dynasty, was this simple 'flying, smashing and bursting bomb-cannon' designed to fire small thunder crash bombs.

time in the Far East, and delivered their decisive payloads. Massive stone balls therefore triumphed where both old-fashioned traction trebuchets and modern explosives had failed

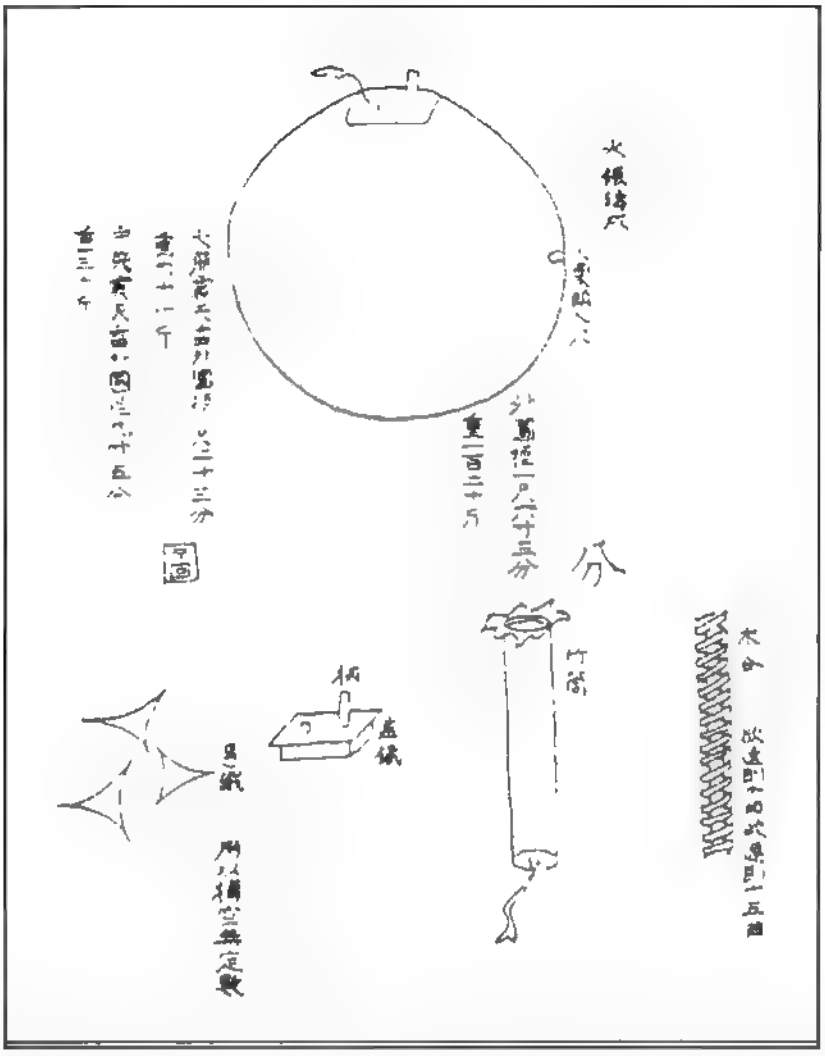
The next mention of the use of thunder crash bombs by the Mongols was during the invasion of Japan in 1274, in the famous encounter on the beaches of Hakata Bay when the Japanese experienced gunpowder weapons for the first time. The incident was immortalised for all time in the *Moko Shurai Ekotoba*, the painted scroll that a samurai called Takezaki Suenaga commissioned to back up his claim for reward, in return for his military service. A thunder crash bomb is shown exploding in front of a mounted samurai; the casing has burst, sending its contents towards the Japanese.

That more than just gunpowder could be packed into a thunder crash bomb is evident from a Yuan dynasty document of *c*.1350 concerning the 'bone-burning and bruising fire-oil magic bomb', which contained 'tung oil, urine, sal ammoniac, faeces and scallion juice' along with iron pellets. Not surprisingly, 'when it bursts it breaks into pieces which wound the skin and break the bones and blind their eyes', thus combining the power of an explosive iron casing with the noxious poison bombs described in Volume 1.

The basic design of the thunder crash bomb was so simple and so effective that it continued to be used as a siege weapon throughout the period covered by this book. Piles of discarded thunder crash bomb shells were noted in 1522 by a visitor to Xian, and in 1626, when Ningyuan was successfully defended against attack from the Manchu leader Nurhachi, thunder crash bombs were used against the Manchu assault ladders, although their means of propulsion is not known.

When mortars were developed, delayed-action iron bombs were an obvious alternative to spherical stones for lobbing over castle walls during a siege, because the mortar used the high trajectory of the trebuchets combined with the longer range of cannon. The earliest Chinese mortars developed during the Ming dynasty were short, bottle-shaped guns called 'flying, smashing and bursting bomb-cannon' designed to fire thunder crash bombs, but it is to Korea we must look to find the best combination of mortars and thunder crash bombs in the Far East.

The first mortar seen in Korea was apparently Chinese, retrieved from a Ming ship in about 1413, from which Korean gunsmiths developed the *wan'gu* (bowl mortar) The *Yungwon P'ilbi* describes the 'extra large' variety as being 'the best firearm for attacking castles or walls because it is loaded with thunder crash bombs and stone balls'. It had a range of 350 *po* (520 yards) for iron bombs, and 400 *po* (600 yards) for stone balls. Some mortars were of two-piece construction



The details of the construction of the Korean version of the thunder crash bomb as shown by a drawing in *Yungwon p'ilbi*. This is quite a sophisticated weapon made from two cast iron hemispheres with a fuse wrapped round a cylindrical core.

and consisted of a powder chamber and the bowl into which the chamber slipped. Rings round the edge of both enabled them to be lashed tightly together using ropes. For portability they were mounted on wheeled carriages.

A dramatic account of the use of thunder crash bombs fired from a mortar comes from the book *Chingbirok* written by Yu Song-nyong, who was Prime Minister of Korea during the Japanese invasion. In September 1593, Korean guerrillas under the leadership of a certain Pak Chin determined to recapture from the Japanese the fortress of Kyongju. A 'flying thunder crash bomb' was fired over the walls and rolled into the courtyard, at which the curious 'robbers', as Yu perceptively calls the Japanese, gathered round to discover what the strange object could be. At that moment it exploded, sending shards of iron far and wide and causing 30 casualties. Such was the concern caused by this secret weapon that the Japanese abandoned Kyongju and retreated to the safety of their coastal fortress at Sosaengp'o. This story, which is doubtless authentic, sums up the devastating combination of mortar and thunder crash bomb which the Koreans had brought to perfection. The invention was credited to a certain Yi Chang-son, who had produced a clever double fuse for igniting the mortar and the bomb in one go. The bomb itself was also more sophisticated than the original 'iron bottle gourd' design, although whether this was a Korean innovation or a Ming one is not clear.

The Kyongju incident also illustrates better than any other episode how backward the Japanese were in terms of heavy guns and explosives compared to continental Asia. It is also highly ironic that most of the invading Japanese troops were from the island of Kyushu, which had suffered the Mongol invasion in 1274. As the thunder crash bombs were almost identical to the ones used then, it could well have been the case that among the injured were lineal descendants of the samurai who had experienced such an attack three centuries earlier! The surprise expressed at Kyongju also makes it unlikely that the Japanese used

thunder crash bombs themselves prior to the Korean War, in spite of the existence of nineteenth-century woodblock prints in which heroes of the battle of Kawanakajima in 1561 are shown in action against these weapons. They may well have been used at Osaka in 1614, however, because we do know that iron shields were issued to assault parties.

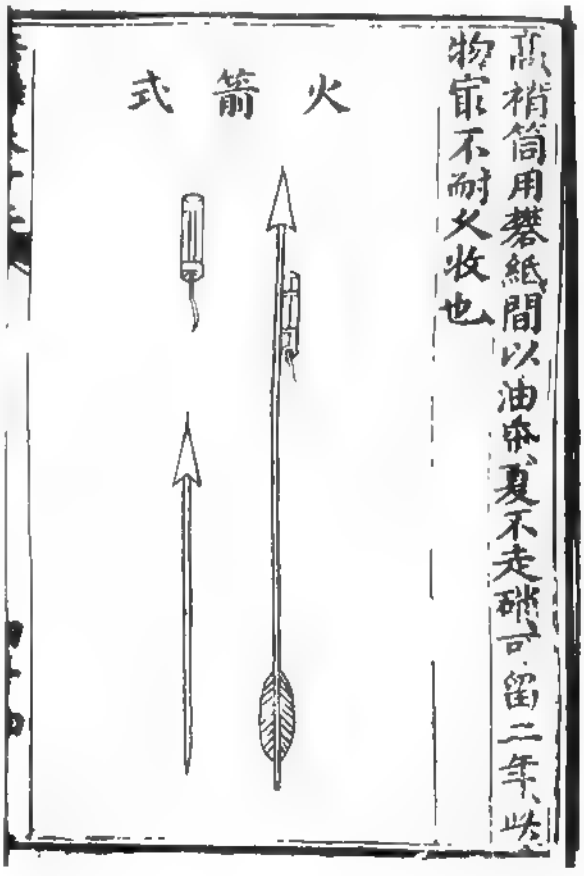
Landmines

Landmines were also part of Chinese siegecraft. The simplest sort were just large explosive bombs placed at a spot where one's enemy was expected, and then detonated using some form of time fuse. A dramatic incident involving just such a planned delayed explosion occurred in 1277, when Guilin in Guangxi province, one of the last outposts of Southern Song resistance to the Mongols, lay under siege. When the main citadel fell, a truce was arranged so that the garrison could receive supplies prior to an honourable surrender. During the interim, some Mongol soldiers climbed up on to the now undefended walls. Suddenly there was an enormous explosion that brought down the wall and the Mongols with it. The Southern Song defenders had prepared a huge bomb at its foundations, and had ignited it at just the right moment.

The correct timing of a landmine's explosion was, of course, the crucial point in the operation of these otherwise haphazard weapons during a siege operation, but it is amazing to note the existence of a device whereby the advancing enemy himself could detonate the explosion. The pressure of a foot on the concealed mine released a pin, which allowed a weight to fall. The weight was attached to a cord wound round a drum, and the rotary movement thus produced caused steel to be rubbed against flint, thus producing sparks which ignited tinder and set off a fuse, so exploding the mine. This must be the first use of the flintlock mechanism in history.

The Japanese also appear to have used landmines, although these were probably not the sophisticated models of the Chinese. In an account of the siege of Osaka in 1615, Mori Katsunaga is described as leaving a landmine behind as he retreated. The device exploded under the advancing troops of Todo Takatora.

The basic design of a rocket arrow as used both in Ming China and Choson Korea.



ROCKETS

Rockets could well have been invented by accident when a soldier holding a fire lance dropped it, only to see it shoot off behind him! In fact, in the past descriptions of fire lances were often thought to be concerned with rockets, but another source for the discovery of rockets in China is likely to be the tiny anti-personnel devices called 'ground rats'. These were effectively little rockets fitted with spikes that were released by explosion, similar to the flying swallows

mentioned above. The ground rats flew around at random like jumping jacks and attached themselves to clothing and armour, causing burns and irritation. At some stage, it must have occurred to someone to attach a large ground rat to an arrow and fire it from a tube, thus producing the world's first rocket-powered missile. The tubes were sometimes decorated with carved dragons' heads, which added a magical quality to these weapons.

It was also realised that several rockets could be launched from the same container, so we read of rocket launchers made of wood or basketwork and carried by a man. In both China and Korea, larger versions were designed to be transported on wheeled vehicles. In China this was a wheelbarrow. In Korea, a two-wheeled cart was used, making a device known as a *hwach'a*, which could hold 100 rockets. It was invented in 1451, and saw service during the Japanese invasions, particularly at the siege of Haengju in 1593. The timing of such a 'now or never' weapon was of course crucial, but at Haengju the dense ranks of confident samurai advancing up the hill presented an ideal target. Two forms of rocket existed: one like darts with built-in propellant, and the other, rocket tubes attached to feathered arrows.

A more entertaining version of the Chinese self-propelled rocket was the 'flying crow with magic fire'. Its construction is described as follows

'The body is made of bamboo laths forming an elongated basketwork, in size and shape like a chicken, weighing over a catty *(1.3lb). It has paper glued over it to strengthen it, and it is filled with explosive gunpowder. All is sealed up using more*

A Korea *hwach'a* reconstructed in the grounds of the Toksugung Palace in Seoul. The rocket-firing frame was mounted on a two-wheeled cart, and was the Korean equivalent of the Chinese wheelbarrow vehicle.

paper, with head and tail fixed on before and behind, and the two wings nailed firmly to both sides, so that it looks like a flying crow. Under each wing there are two rockets. The fourfold fuse, connected with the rockets, is put through a hole drilled on the back. When in use, this is lit first. The bird flies away more than 1,000 ft, and eventually falls to the ground, the explosive gunpowder in the cavity of the bird is [automatically] lit, and the flash can be seen miles away.'

Another version was just a round fire bomb fitted with a rocket, but with the addition of bird-like wings.

The 'fire dragon issuing from the water', was, however, the most spectacular of all, as it was made to look like a flying dragon. Its body was a five-foot length of bamboo with a dragon's head and tail. Rockets were concealed within it, but the most interesting point is that two additional rockets attached to its sides delivered it in a low trajectory above the surface of the sea to the enemy over a distance of about 1,800 yards, at which point the other rockets would ignite and fly forth, making it the world's first two-stage rocket.

ABOVE LEFT **The round rocket bird, a simple rocket device given wings like a bird.**

ABOVE RIGHT **The fire dragon issuing from the water, the most fascinating version of a Chinese rocket that worked on the principle of a two stage rocket. The rockets shown prominently at the sides were the first to be ignited.**

SIEGE CANNON

The First Chinese Cannon

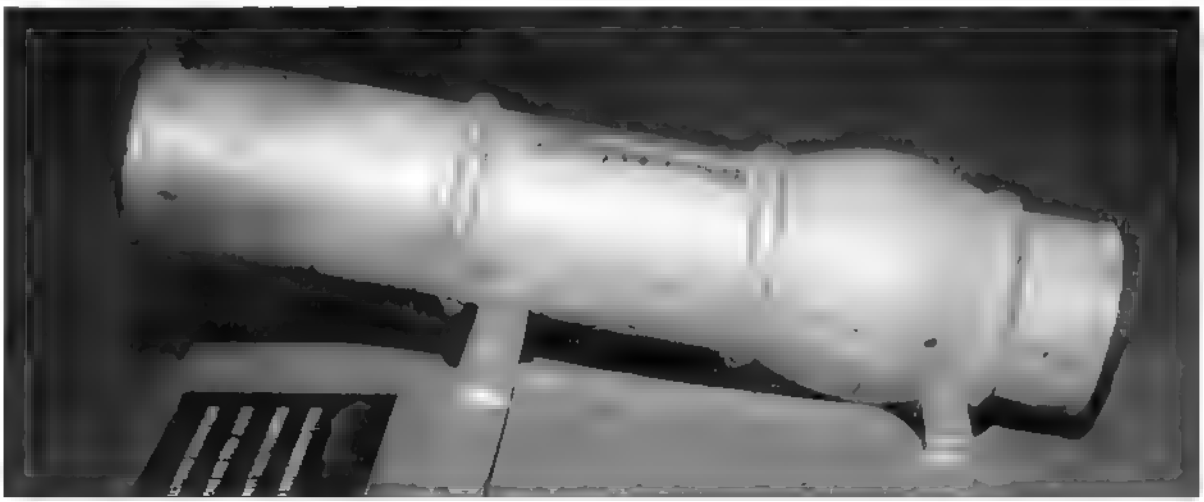
The transition from the thirteenth to the fourteenth century marks the change from catapult artillery to the introduction of metal-barrelled cannon, a development that coincides with the replacement of the Yuan by the Ming dynasty. The earliest guns in China, and also in the world,

ABOVE **Early Chinese cannon were simple cast iron bombards as in this example shown here, which has a calibre of 4.15 inches, and an overall length of 18.7 inches. Note the bulbous shape around the touch-hole to add strength. It was made during the fourteenth century. (Royal Artillery Museum, Woolwich)**

BELOW **A Chinese cast bronze gun bearing an inscription that it was made in 1409. It is 2 feet long (Royal Artillery Museum, Woolwich)**

are small weapons dating from the early fourteenth century, although the oldest known specimen is believed to date from about 1288.

As for Chinese cannon as distinct from handguns, the oldest are reliably dated as 1356 or 1357. They are of cast iron and weigh between 132 and 660 lb each, making them much smaller than European models. When Philip the Bold, Duke of Burgundy, achieved the first European siege victory using guns in 1371, he used bombards that fired 200-pound balls. Although much smaller, the Chinese cannon were actually used in sieges, and we have a reliable date of 1358 for this, at the siege of Shaoxing, where cannon and handguns were used in large numbers by both sides, firing both stone and iron projectiles. We can have a good idea of the size of the cannon used from stone cannonballs of the same period excavated at the palace of Shangdu (Khubilai Khan's 'Xanadu'). The projectiles were three and four inches in diameter, much smaller than the Duke of Burgundy's monsters. By the time of the siege of Suzhou in 1366, much larger cannon were being produced, such as the 'bronze general', but none came near to the size of the European models.



The date of 1366 also provides a fascinating juxtaposition, because at the siege of Suzhou we find trebuchets being used side by side with cannon. The besiegers:

'... built up wooden frameworks like pagodas, as if answering to the pagodas in the city. As these enemy towers were three storeys high, those on them could look down into [the city]. Each level was furnished with bows, crossbows and cannon. Xiangyang trebuchets were also set up to batter the city, and everyone inside was very frightened.'

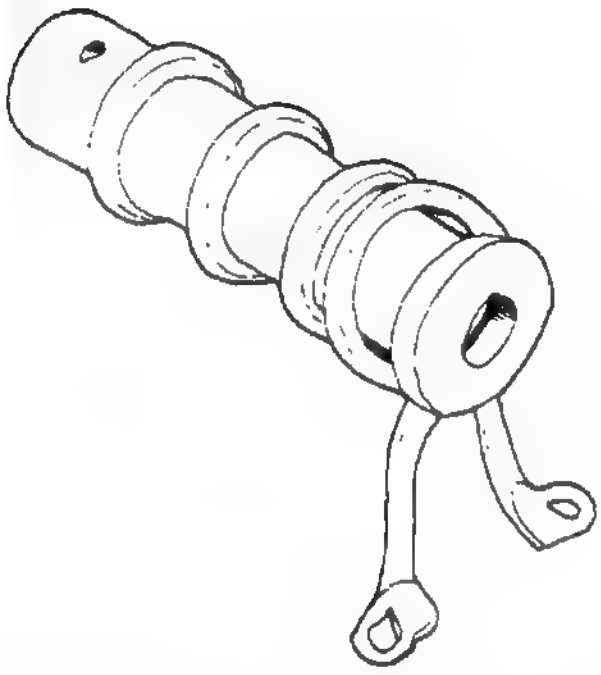
In contemporary Europe, any constraints on the use of siege cannon were as much economic as military. Unlike trebuchets, which were built on site by carpenters, cannon were forged by specialists in foundries and had to be laboriously transported to the siege lines. If one split while in action, repairs in the field were virtually impossible. The cost of firing one was also enormous, so the presence of one or even two bombards at a fourteenth-century siege was something of a rare occurrence. By the mid-fifteenth century, it was realised that smaller cannon, which could be more numerous and more portable, could do the job of reducing a castle as well, if not better, than one large bombard. The result was that whereas Chinese siege cannon started small and grew larger, European ones started large and grew smaller.

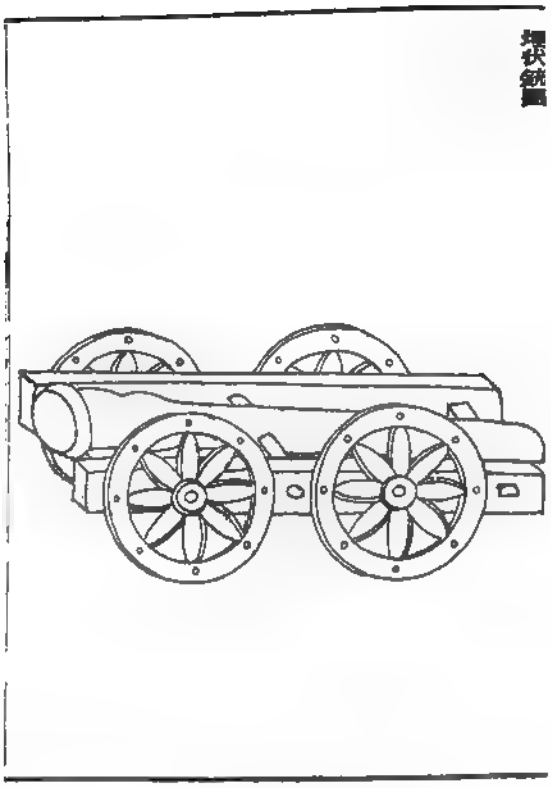
The means of construction of Chinese cannon was also different. Early European iron cannon were manufactured from wrought iron, made from staves hammer-welded together and strengthened by hoops, just like a wooden barrel, a process which may well explain the use of the term 'barrel' for a gun. Cast guns, on the other hand, were made of bronze, using techniques similar to bell founding. The first Chinese guns were also of cast bronze, but cast iron was being used in China from 1356 onwards. Early examples had a bulbous end around the touchhole to strengthen it, but as technology improved this shape was dispensed with, although the barrel then tended to have hoops along its length. This was possibly in imitation of the strength naturally given to bamboo by banding, and it made the Chinese guns look like small versions of European hooped bombards. These primitive Chinese cannon were clearly valued as defensive siege weapons, because a Ming edict of 1412 ordered the stationing of batteries of five cannon at each of the frontier passes as a form of garrison artillery.

Some designs of Chinese cannon saw very long service. For example, the 'crouching tiger' cannon, which dates from 1368, the beginning of the Ming dynasty, was still being used against the Japanese in Korea in 1592. It was fitted with a curious loose metal collar with two legs so that it needed no external carriage for laying. Another was the 'great general' cannon, of which several sizes existed, and an account of 1606 notes that 300 different great general guns were made in 1465. Ye Mengxiong, who lived in the second half of the sixteenth century, 'changed the weight of the gun to 250 *catties* (330 pounds) and doubled its length to six feet, but eliminated the stand and it is now placed on a carriage with wheels. When fired, it has a range of 800 paces ' The enthusiastic description continues:

'A single shot has the power of thunderbolt, causing several hundred casualties among men and horses. If thousands, or tens of thousands, were placed in position

Later versions of Chinese cannon abandoned the strengthened area around the touch-hole, but incorporated rings along the barrel's length. This did not, however, indicate that they were of hoop and stave construction like European bombards, but were probably built this way in imitation of the natural strength possessed by bamboo. (Royal Armouries Museum, Leeds)





along the frontiers, and every one of them manned by soldiers well trained to use them, then [we should be] invincible. ... At first its heavy weight caused some doubt as to whether or not it was too cumbersome; but if it is transported on its carriage then it is suitable, irrespective of height, distance, or difficulty of terrain.'

It is more than likely that great general guns made up much of the 700-piece artillery train that the Ming used in their campaign against rebels in Ningxia in 1592, just prior to joining in the Korean campaign against Japan.

Breech-loading Cannon

Both the crouching tiger and great general guns were Chinese originals dating from the early Ming period, but from the early sixteenth century onwards a different type entered the Chinese arsenal from Europe. It was known as the *folang zhi*, which means 'Frankish gun', 'the Franks' being a general term for any inhabitants of the lands to the West, and was of a fundamentally different design from the great general, as these new weapons were breech-loaders.

Breech-loading, which we tend to think of as a modern artillery innovation, has in fact a long history in European gunnery. Instead of being rammed down from the muzzle, the ball was placed inside from the breech end, while powder and wad were introduced into the breech inside a sturdy container shaped like a large tankard with a handle. It was made from the same metal as the rest of the gun. Alternative designs kept the ball separate from the charge. A metal or wooden wedge was driven in behind it to make as tight a fit against the barrel opening as could reasonably be expected, and the gun was fired. Breech-loaders were used

ABOVE LEFT **The 'crouching tiger cannon' of the Ming dynasty, which saw long service and was adopted by Korea, who used it against Japan during the war of 1592–98.**

ABOVE RIGHT **A Ming dynasty cannon mounted on a wheeled carriage.**

OPPOSITE TOP **The ubiquitous Portuguese breech-loading cannon, which was adopted by Ming China as the 'folang zhi', by Korea as the 'feringi', and by Japan as the 'furangi'. (Royal Armouries Museum, Leeds)**

OPPOSITE BOTTOM **A longitudinal section of a breech-loading cannon, showing how the separate breech containers were fitted in. They were held in place by a wedge hammered in behind them.**

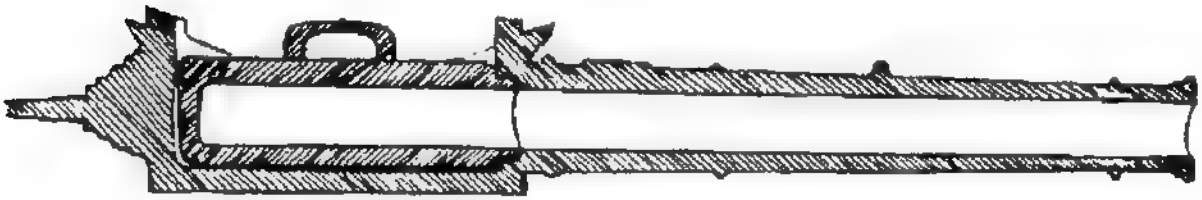
in Europe from about 1370 onwards, and were clearly most suitable for the smaller sizes of cannon. They were also a popular choice for naval warfare, because they did not need to be hauled in to be swabbed out and reloaded before being run out again for firing. The main disadvantage was leakage around the muzzle and a consequent loss of explosive energy, but this was compensated for by a comparatively high rate of fire, as several breech containers could be prepared in advance.

It was once believed that the first 'Frankish piece' came to China from Portugal via a shipwreck in 1523, but it is now believed that the transmission occurred some time earlier. The description of an early folang zhi notes that it weighed about 200 *catties* (264 pounds). Its chambers, of which three were supplied for rotational use, weighed 30 *catties* (40 lb) each, and fired a small lead shot of 10 oz. By 1606, the breech-loading principle had been extended to larger guns. One such cannon, called the 'invincible general', was favoured by the famous Ming general Qi Jiguang. It weighed 1,050 *catties* (1,386 pounds), was mounted on a wheeled carriage and could fire grape shot over 200 feet.

Cannon and the Manchus

Another European cannon came China's way very early in the seventeenth century, when a huge gun, larger than any seen in China up to that time, was obtained from a visiting European ship. It was 20 feet long, and weighed 3,000 *catties* (4,000 pounds). Because of its origin, the weapon was christened the 'red[-haired] barbarian gun', and it was remarked that it could demolish any stone city wall. In size alone it must have been a 'one-off' for China. The Ming were so impressed that the Portuguese in Macao were invited to send artillery units north to Beijing to defend the capital against the Manchu threat, and the Jesuit priests who accompanied them were put to work setting up a cannon foundry, which they did with some success.

'Heaven has favoured us and has given these barbarians of Ao (Macao) to fortify our cities,' wrote one scholar, and the Ming attributed their success in holding the Manchus at bay outside the Great Wall to their superiority in firearms of all sorts. An interesting account is given in the notes of a Portuguese embassy in 1621, when three cannon were presented to the emperor. 'A test was performed in Peking in the presence of the mandarins who were surprised at first and then dismayed when they saw that having fired one of the pieces the recoil killed a Portuguese and three Chinese who did not withdraw quickly enough.' Nevertheless, 'the cannon were brought to the frontier of the empire, at the borders with the Tartars (Manchus) who having come with troops close to the Great Wall were so terrified by the



damage they did when they were fired that they took to flight and no longer dared to come near again.'

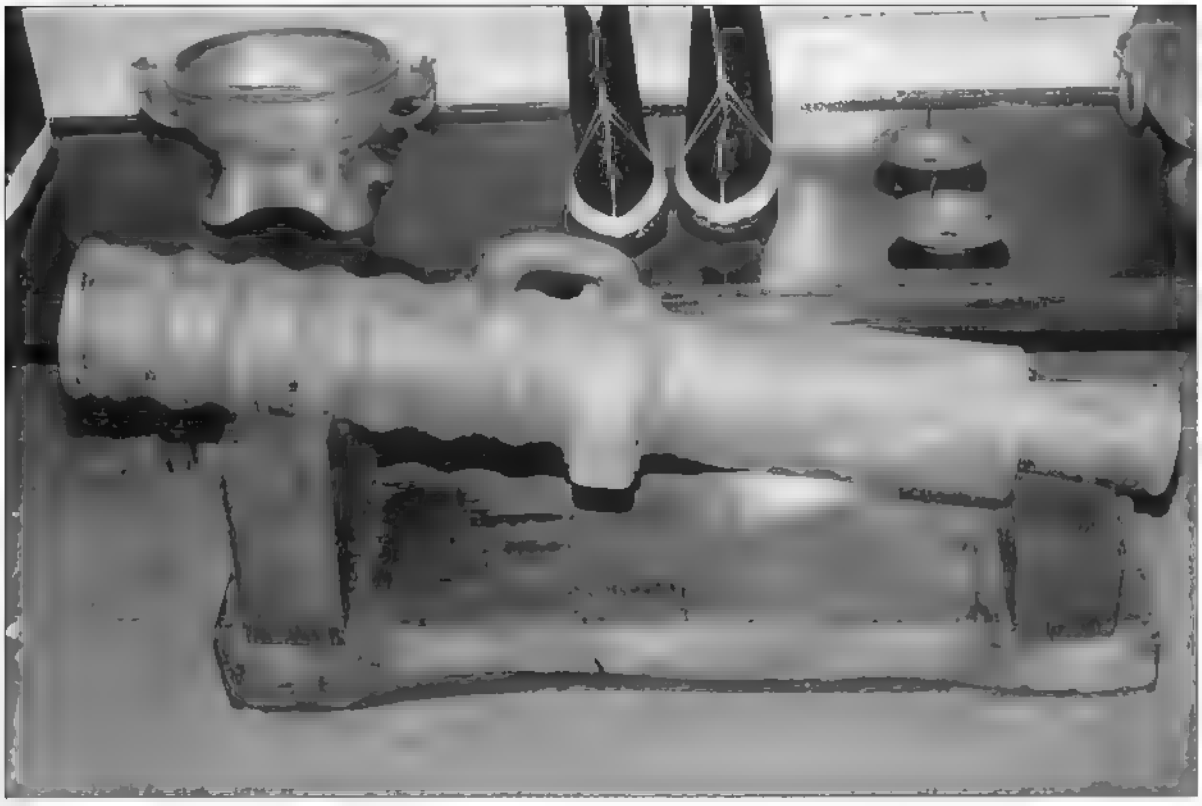
The success of the Jesuit arsenal is illustrated by the example of Johann Adam Schall von Bell, Director of the Astronomical Bureau, who was pressed, under protest, into ordnance service in 1642. He supervised the casting of 20 40-pound saker-type cannon that year and 500 the next. The founder of the Manchu dynasty, Nurhachi, who died in 1626, had made great efforts to obtain guns of his own, and by 1640 it was reported that his successors had forged 60 cannon 'too heavy to carry round'. Other rebels against the Ming had firearms too, including Li Zicheng, who eventually overthrew the dynasty. In 1642, two years before he took Beijing, cannon are noted as playing a decisive role in one of his victories.

At top, a Korean mortar in pieces. At bottom, a Korean gun and a wooden arrow, the favourite missile for firing from cannon. They were tipped and 'feathered' with iron, and the largest varieties were about nine feet long.

Siege Cannon in Korea

The repeated attacks on their coast by Japanese pirates led Korea to adopt firearms as defensive weapons during the fourteenth century. At first, both weapons and gunpowder were obtained from China, but it was not long before Korea was manufacturing cannon of her own. As they were first intended for naval warfare, these early cannon cannot be considered siege weapons as such, but their designs were so efficient that they remained in use for many years, and were employed in siege situations during the Japanese invasions.

Korean cannon of the fourteenth century differed from Chinese ones chiefly in the missiles fired from them. Instead of stone balls, the Koreans preferred heavy wooden arrows up to nine feet long tipped with iron, which could be fired about 200 paces. They had considerable hitting power, particularly when delivered against the wooden hull of a ship, and showed their worth during the sea battles of the Japanese invasions. During the test firing of one variety the arrow buried itself into the ground up to its metal 'feathers'. The projectiles could also be converted into fire arrows.



A Korean 'black' cannon at the Chesundang on Hansando island. The barrel would be secured to a carriage by ropes. These efficient weapons were used both on board ship and from castle walls.

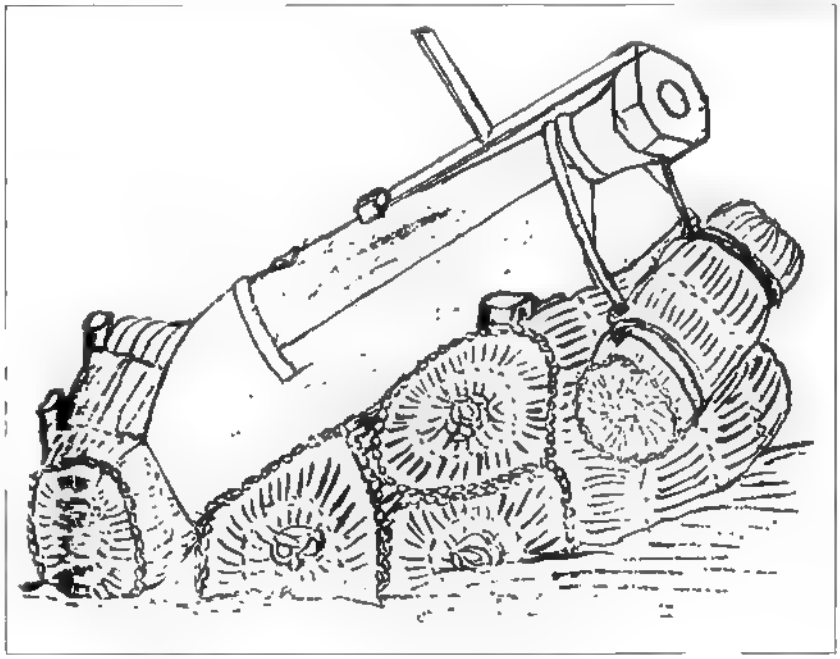
Firearm production and development increased under King Taejong, and by 1415 some 10,000 guns of various sizes, from hand-held weapons to heavy cannon, had been issued to 100 provincial and coastal castles as well as the Korean navy. In fact, so many bronze guns were being cast that there was a shortage of copper, and the government was forced to requisition temple bells to be melted down. By the 1420s, iron cannon balls began to replace stone ones, and four types of cannon were standardised in a classification that was to last for almost two centuries. The four sizes were called *ch'onja* (heaven), *chija* (earth), *hyonja* (black) and *hwangja* (yellow). The names have no particular significance, and refer to the first four characters of a classic Chinese poem used for learning the alphabet, making them effectively cannon types A, B, C and D. The heaven cannon was the largest, comparable in size to the popular great general cannon of the Ming, and could fire the largest wooden arrows over 1,300 yards, while the earth and black types could project their respective arrows a staggering 2,100 yards. Gun crews consisted of three people, a 'gunner' a 'loader' and an 'aimer'. The cannon were mounted on neat wooden carriages and could be drawn by horses.

By the mid-sixteenth century, Korea's four 'native' cannon had been supplemented by imports of the Ming great general and crouching tiger cannon. Even though there was no contact between Europe and Korea at this time, the Koreans also obtained Portuguese breech-loaders of identical appearance to those acquired by China, and also called them by the similar name of *ferringi*. Ming China is the obvious source of supply for these guns, because the Koreans did not manage to cast their own versions of them until 1597.

Siege Cannon in Japan

In Japan, the development and use of cannon lagged centuries behind that of China and Korea. Soft-cased exploding bombs fired by catapult remained Japan's only artillery until the sixteenth century, and it was not until 1510 that any form of metal-barrelled gun was introduced to this most militaristic of East Asian societies. In that year, Hojo Ujimasa acquired a sample of a simple Chinese handgun. Although accounts of them being used in battle are rare, the description of the battle of Uedahara in 1548 shows that their use had diffused from the Hojo family to other clans. In 1543, there occurred the epic landfall of Portuguese traders on the island of Tanegashima, bringing with them European arquebuses. Within a few years these weapons had been copied, improved and mass-produced, and large numbers of Japanese arquebuses were being used in battle from 1549 onwards. Chinese handguns were rapidly forgotten.

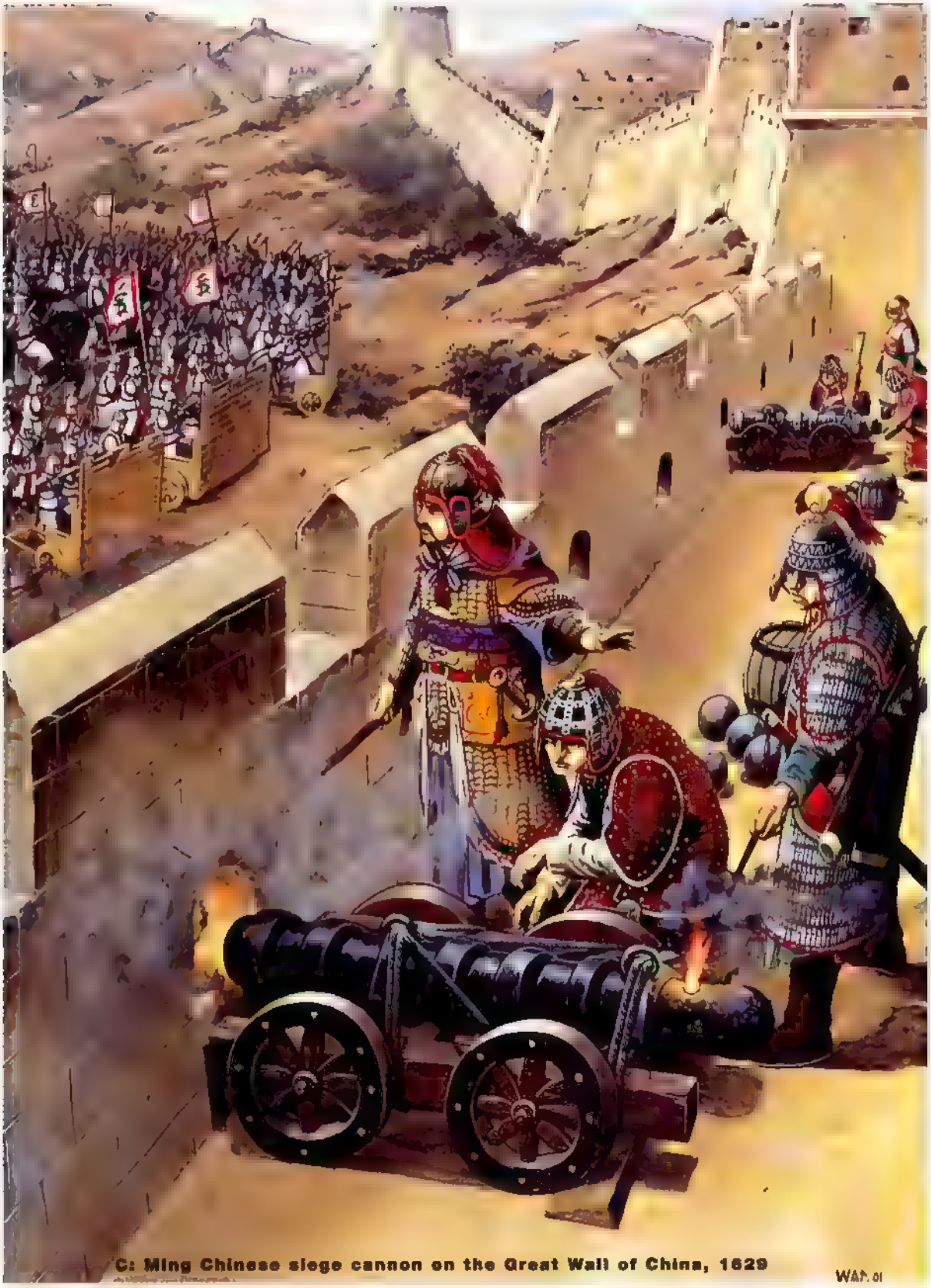
Cannon, however, do not appear to have inspired such enthusiasm, and it is something of a mystery as to why this should have been. Japanese pirates (many of whom led respectable and influential lives at home) had been subject to Korean cannonades for over a century, and on one memorable occasion a Portuguese ship was persuaded to use its firepower in a dispute between two samurai families. This happened in 1561, when a Portuguese vessel bombarded the castle of Moji on behalf of the Otomo clan. The psychological effects on the defenders were every bit as serious as the very real damage that was done to their physical defences, but instead of this leading to a cannon revolution comparable to the arquebus revolution of 1543, the dramatic demonstration seems to have been virtually ignored. Instead, we read sporadic references to the use of cannon in Japanese sieges, but nothing comparable to the widespread and large-scale use of siege artillery that was transforming the face of European warfare.



A small Japanese bronze cannon sunk into a wooden framework and mounted on a pile of rice bales stuffed with sand.

A: Soft-cased and iron-cased bombs and rockets against the Mongols at Kaifeng, China, 1232

B: Wheeled rocket launchers at Haengju, Korea, 1593



C: Ming Chinese siege cannon on the Great Wall of China, 1629

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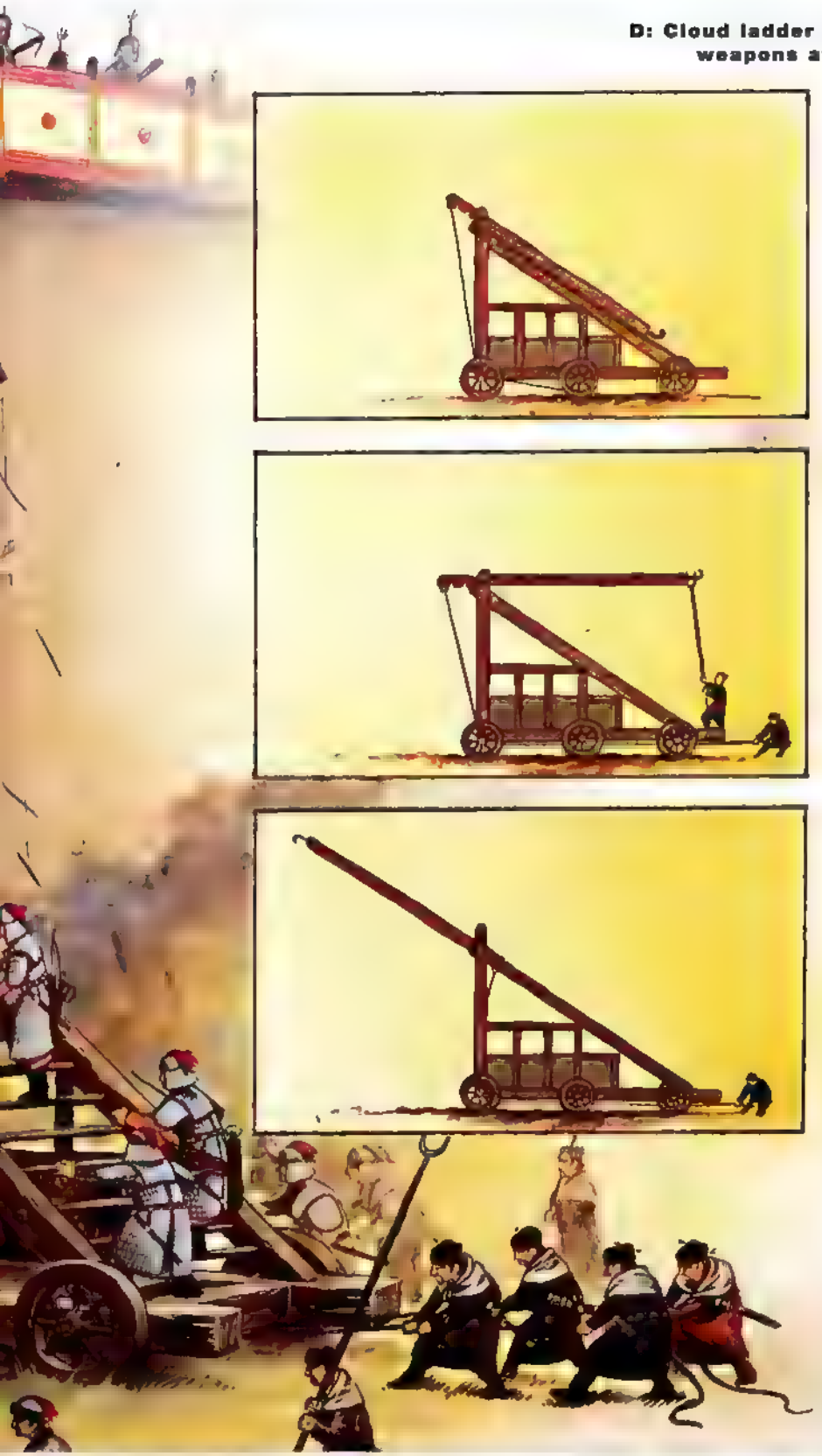
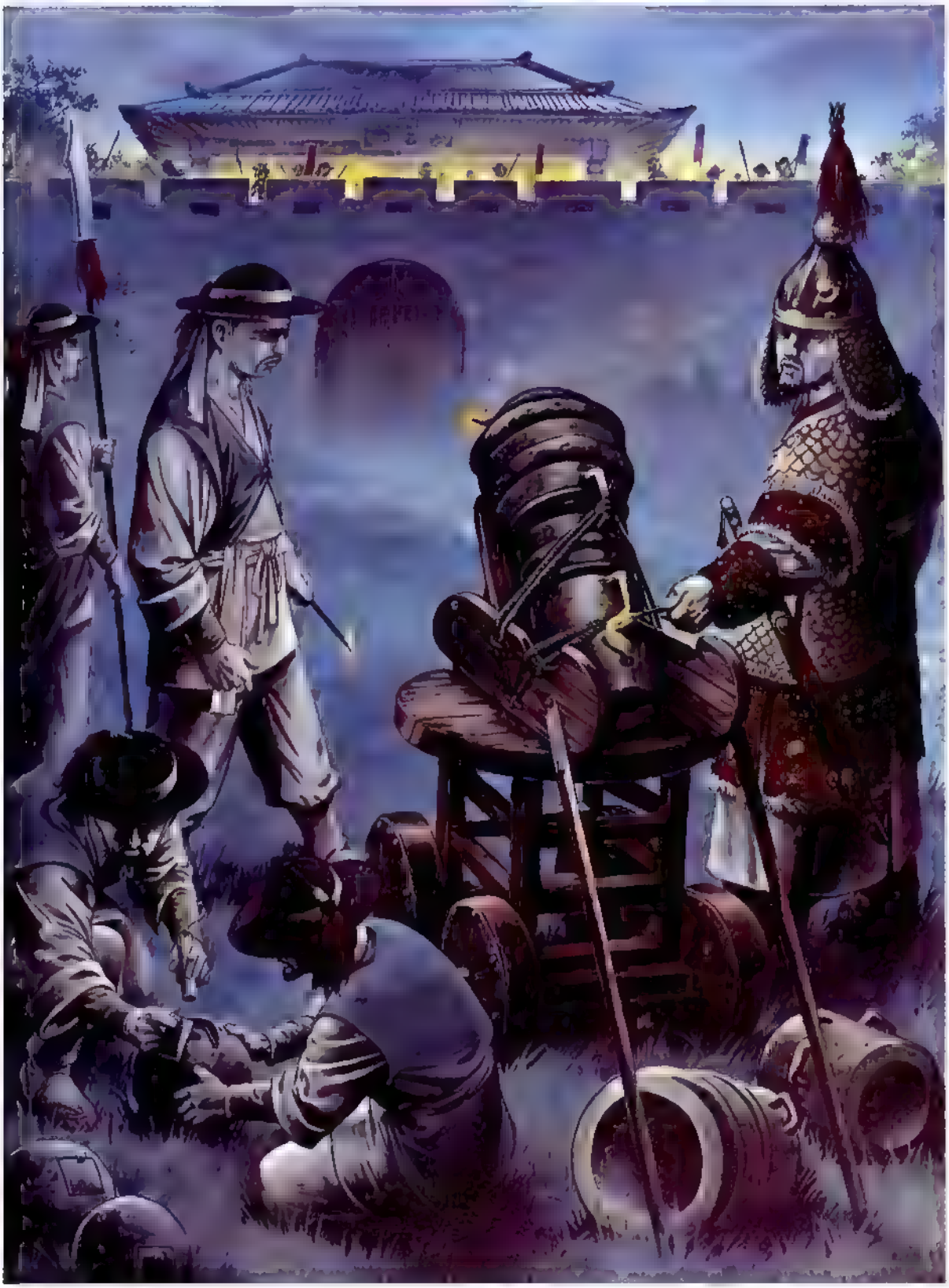
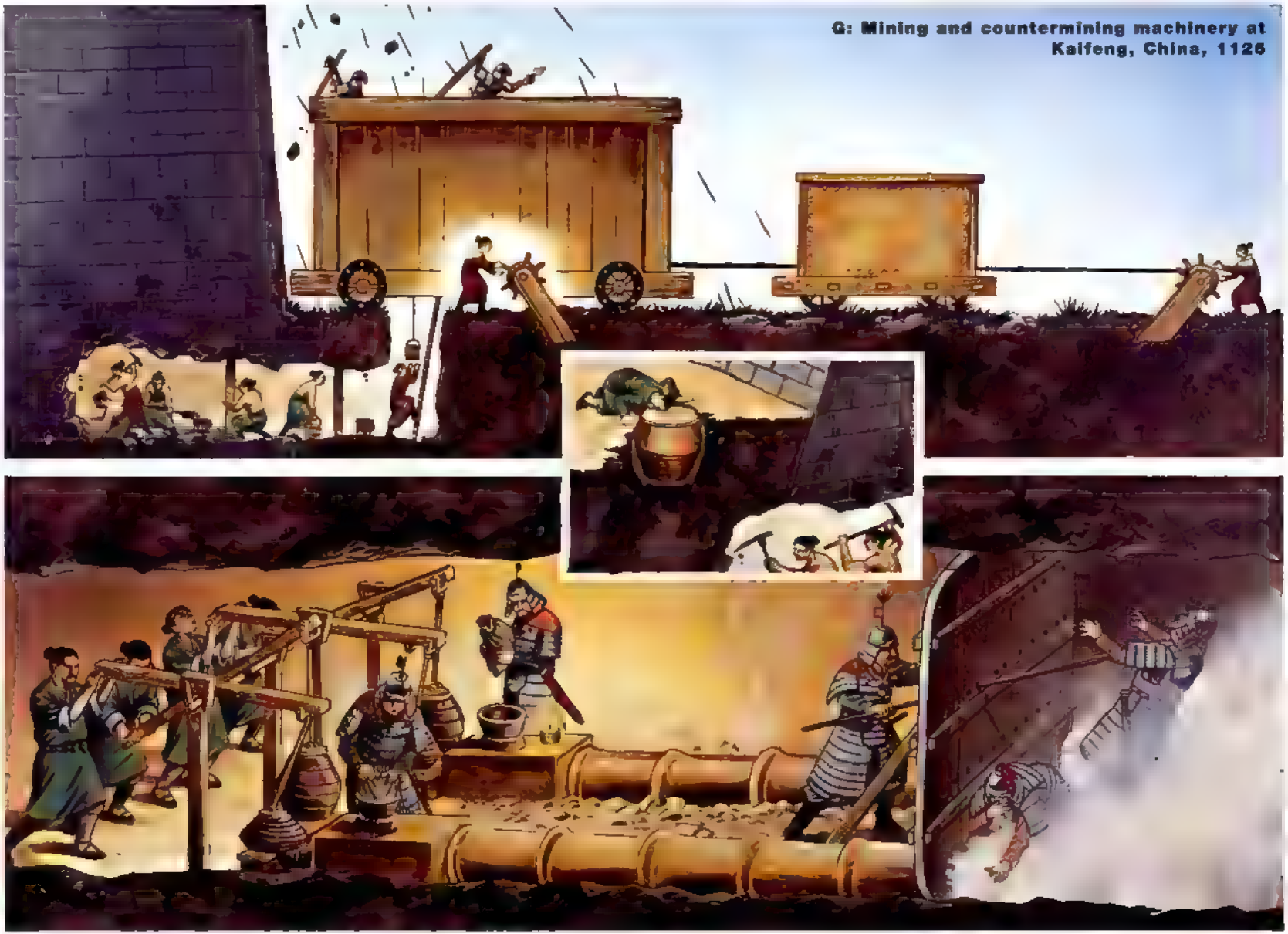
D: Cloud ladder against anti-personnel weapons at Kaifeng, China, 1126




E: European cannon and fire arrows against a castle gate at Otsu, Japan, 1600



F: Mobile mortar and thunder crash bombs at Kyongju, Korea, 1593

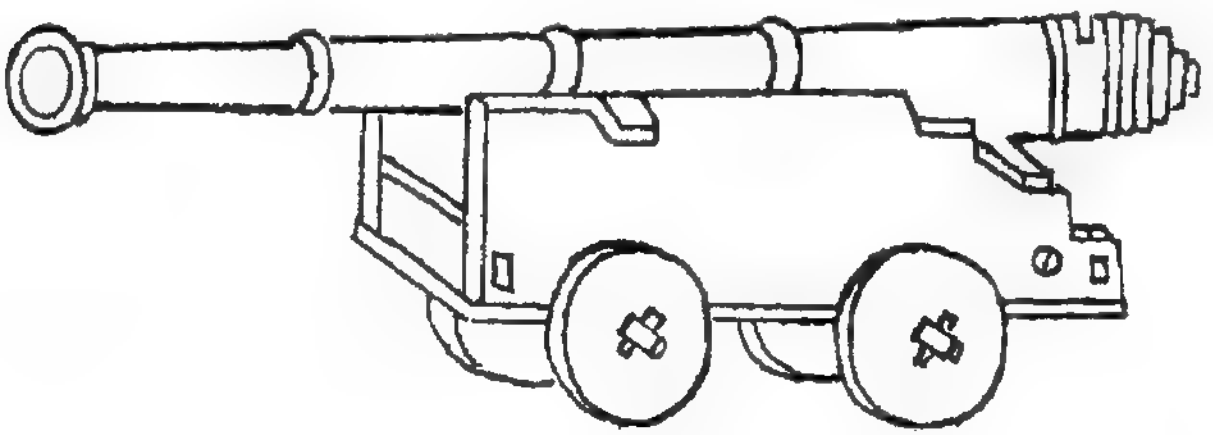


Q: Mining and countermining machinery at Kaifeng, China, 1126

The skills of the Portuguese gun founders in China had already been demonstrated in Japan when some guns were cast in Nagasaki. However, the disruption caused by the persecution of Christians, and the clear preference of the Japanese for cannon made in Europe, ensured that visiting ships were regularly lightened of their cannon as part of trade deals. At the siege of Nagashino in 1575, the defenders had one cannon, which they used to good effect in destroying a Takeda siege tower, but the Takeda themselves brought none. In 1578 the Otomo, whose Christian sensibilities did much to ensure a supply of European weapons, employed one Portuguese breech-loader, identical to the Chinese folang zhi, against the Shimazu castle of Takajo. In spite of its impressive nickname, *kuzurikuni* (destroyer of provinces), it failed to prevent the Otomo from being surprised by a Shimazu relieving army and slaughtered in their thousands along the banks of the Mimigawa. The Shimazu captured the cannon.

The siege of Nagashima in 1574 was accompanied by bombardment from cannon mounted on Oda Nobunaga's ships, but these cannot have been very big pieces, and were probably of similar size to the 'yellow' cannon of Korea. Even the great Hideyoshi used artillery only for what seems more like heavy-calibre sniper fire, preferring to reduce his enemies' fortresses by fire, flood, starvation or assault. The Hojo castle of Odawara boasted many cannon, of which details are unknown, during Hideyoshi's epic siege of 1590, but were unable to prevent its fall.

Most remarkably of all, when the Japanese invaded Korea in 1592 they took almost nothing in the way of a 'siege artillery train' of any sort with them. Initially, at least, this optimism proved to be fully justified, as one Korean castle after another fell to Japanese assault accompanied by fierce arquebus fire. It was only much later in the campaign that the invaders found themselves under pressure from Korean and Chinese cannon, as from the firepower of Admiral Yi's famous turtle-shaped ships. As cannon began to be used effectively from fortresses such as Chinju, the Japanese responded in kind, and mounted cannon, many of which were captured from the Koreans, on their *wajo* (coastal fortresses), which they then used to keep Admiral Yi's fleet at bay. Yet even these do not sound like artillery fortresses in the European sense, because in the records that exist of the breakdown of weaponry during the time of occupation between 1593 and 1597, cannon figure very slightly. For



A Japanese cannon from a drawing of 1684. This depicts a European culverin mounted on a naval carriage, which is probably how the majority of European cannon in Japanese service were actually deployed.

example, the wajo of Kadok island, which had a garrison of 5,000 men, contained 200 firearms and 4,500 bullets, compared to 300 bows and 6,000 arrows, and 150 of the guns were arquebuses, only one being described as of 'large calibre'.

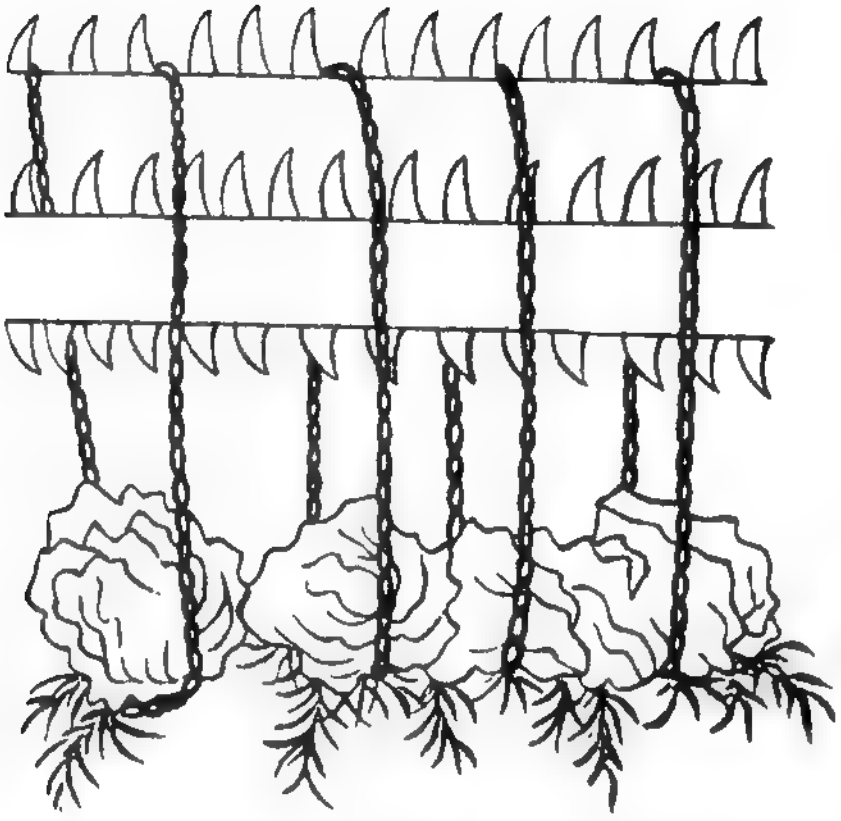
On returning to Japan, certain commanders incorporated the lessons from Chinese siegecraft into the design of their new fortresses. The most enthusiastic supporter of artillery as a siege weapon was Tokugawa Ieyasu, who became the first Tokugawa Shogun following his decisive victory at Sekigahara in 1600. Apart from a few bronze pieces cast in Japan, the majority of the Tokugawa siege artillery consisted of cannon obtained from European, chiefly Dutch and English, ships. The terms 'saker' (usually 31/2 inch calibre and 51/2lb shot) and 'culverin' (usually 51/2 inch calibre and 171/2lb shot) appear in the literature, giving us a good idea of the size and range of these weapons, which were used to their most dramatic effect during the siege of Osaka in 1614. Prior to the siege, Tokugawa Ieyasu bought up all the guns, powder and ball that he could lay his hands on, and the Tokugawa culverins kept up a long-range bombardment of Osaka castle to which the defenders could not hope to reply. Instead of these modern European guns, the Toyotomi had only 'furangi' breech-loaders – the ubiquitous Portuguese model again – and 'fire projecting mangonels', in other words catapults firing soft-cased bombs.

With the establishment of the Tokugawa Peace, artillery became neglected once again. When the Shimabara Rebellion broke out in 1638, the Tokugawa army found itself with little in the way of artillery with which to bombard the rebels, and were reduced to enlisting the services of the Dutch, who obligingly fired a few token cannonballs at Hara castle. The Korean achievement in siege artillery using mortars does not appear to be one of the lessons that the Japanese took home with them in 1598. Nothing is heard of mortars at either Osaka or Shimabara, but later, in 1639, a demonstration of a Dutch mortar caused great wonderment to the representatives of the Shogun who watched it. The demonstration firing went tolerably well, but while they succeeded in blowing the muddy contents of an entire paddy field into the air, none of the explosive shells actually hit its target, which was a peasant's cottage kindly vacated for the occasion. Not wishing to deprive their customers of a conflagration, the Dutch ignited a bomb inside the building, which was utterly demolished to the satisfaction of all.

DEFENSIVE MEASURES AND MACHINES

So far in this work we have been concerned almost exclusively with missile weapons, yet in the design of machines for attack and defence the Chinese showed an ingenuity equal to their innovative use of crossbows and catapults, and such devices were disseminated just as widely among China's neighbours. There is also an equally impressive continuity over a long period of time, and the range of examples that follow reflects this.

Writing during the Warring States Period (550–221 BC), Mo Zi wrote the classic exposition of the principles that lay behind good defence of a town in a state of siege:

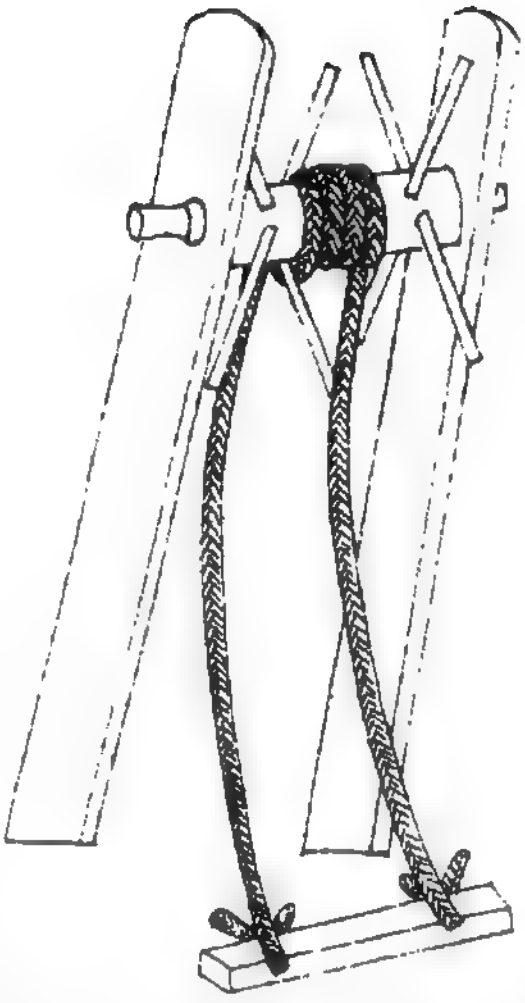


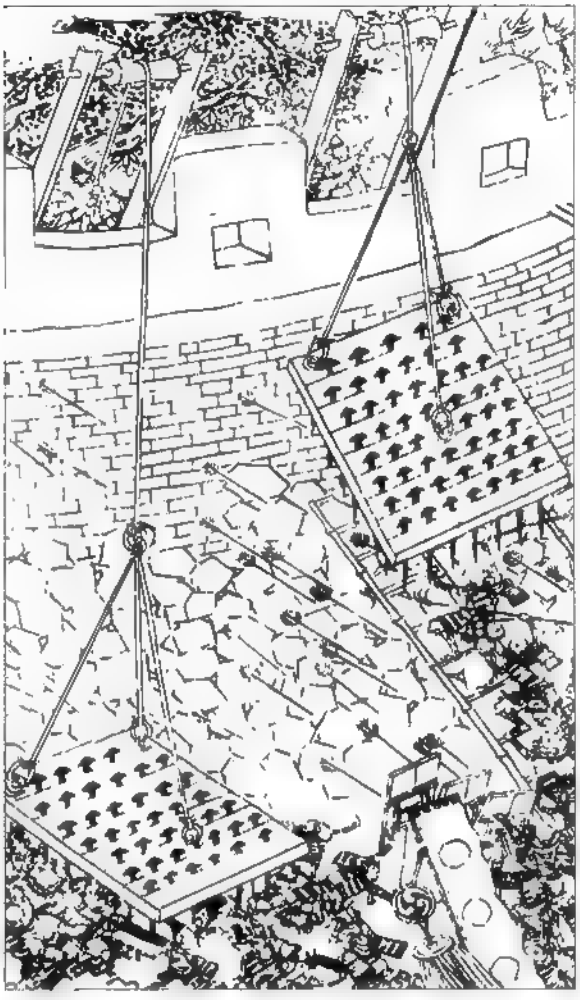
Many ingenious Chinese devices existed for the defence of their walled towns. Here we see slung stones and spiked beams hanging from the wall of a Song fortress.

'... the city walls are to be high and thick; the ditch and moat are to be wide and deep; the towers are to be in good repair; the defensive weapons are to be mended and sharp; the firewood and food are to be sufficient to hold out for more than three months, the men are to be numerous and well chosen; the officers and people are to be in harmony; the important subjects who have merit and long service with their superiors are to be many; the ruler is to be trustworthy and in the right; and the myriad people are to take pleasure in him.'

These principles of preparation and co-operation were to hold good for many centuries of Chinese siege warfare against attacks by crossbow, catapult and ultimately cannon.

The preparations that a Chinese walled town might take to be ready for a siege started long before the enemy actually came into sight. The first need was to block his access, particularly along roads, that could be sown with caltrops; four-pointed metal spikes arranged in a tetrahedron shape so that they always landed with one spike pointing upwards. The Jin did this when the Mongols approached Beijing in 1211. More sophisticated forms of roadblocks consisted of collapsible fences or traps, or old sword blades mounted on boards. A later version was called an 'earth stopper', a flat wooden board into which barbed nails were hammered. A more subtle device was the widespread use of dummy soldiers made of straw and bedecked with flags, to make the enemy think that the garrison was much larger than it actually was. We may note all these points in the Japanese literature too. During the Ming siege of the Japanese fortress of Ulsan in Korea in 1597, an enterprising samurai





ABOVE LEFT **A windlass for lowering troops down the outside of the walls of a defended town to allow them to fight hand to hand and then be pulled up to safety again.**

ABOVE RIGHT **The use by the Korean garrison of the formidable wolf's tooth striking board at the siege of Chinju by the Japanese in 1593. The spiked board was dropped on to scaling ladders and then hauled back for re-use by means of a windlass.**

constructed a fence out of discarded Chinese swords, and the use of dummy troops was a feature of Kusunoki Masashige's famous defence of Chihaya castle in 1333.

When an attack became imminent, the countryside around was scoured for anything that could be of use to an enemy. Wells were blocked up or poisoned, and sharp bamboo stakes placed just under the waterline in flowing streams and rivers. All metal objects, including agricultural implements, were brought inside the walls, and even the building materials for people's houses were requisitioned for repairing walls damaged by trebuchets, on the understanding that if the materials were not used they would be returned or otherwise compensated for. The empty spaces of a town therefore began to resemble a lumberyard, with stacks of firewood separated from piles of stout beams that could be used for making trebuchets. They were plastered over with mud to make them fire resistant against incendiary attacks, or, in the case of the trebuchet beams, kept in water. All food sources were removed from the surrounding area and brought inside the walls, and the mass of evacuated civilians was assigned to appropriate duties.

The soldiers of a garrison would man the walls, where hand-held weapons such as axes, maces, hammers, halberds and flails were kept

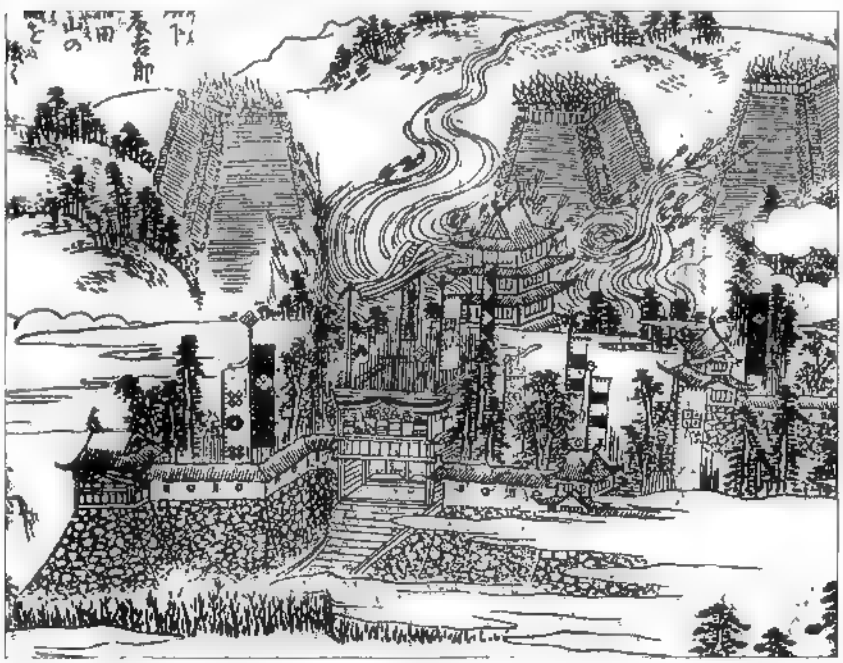
ready for destroying the enemy's scaling ladders. Piles of stone missiles were established, either for firing from catapults or to be dropped by hand. Numerous vessels were also made ready, including the portable furnaces for melting iron as described in Volume 1, together with sand buckets, water buckets and latrine buckets, which could also be used in the appropriate manner as anti-personnel devices. Distinctively coloured flags were flown at the various duty stations, thus making a Chinese city under siege a very colourful sight.

Meanwhile, the soldiers of the garrison made ready to fight off the wide variety of machines that might be brought against them, for which they had some elaborate defensive machines of their own. At various points along a wall were erected windlasses that could be used for lowering men against an attacker to fight hand to hand, and then pulling them back up to safety. Similar windlasses could also operate the stout wooden cylinders spiked with iron and known as 'thundersticks', or the fierce-looking 'wolf's tooth striking board', which was a large square wooden board pierced with nails that could be lowered or dropped suddenly to crush a waiting assault party or to sweep men off their ladders. Huge rams not unlike the battering rams described below were also mounted on parapets to be swung against siege machines.

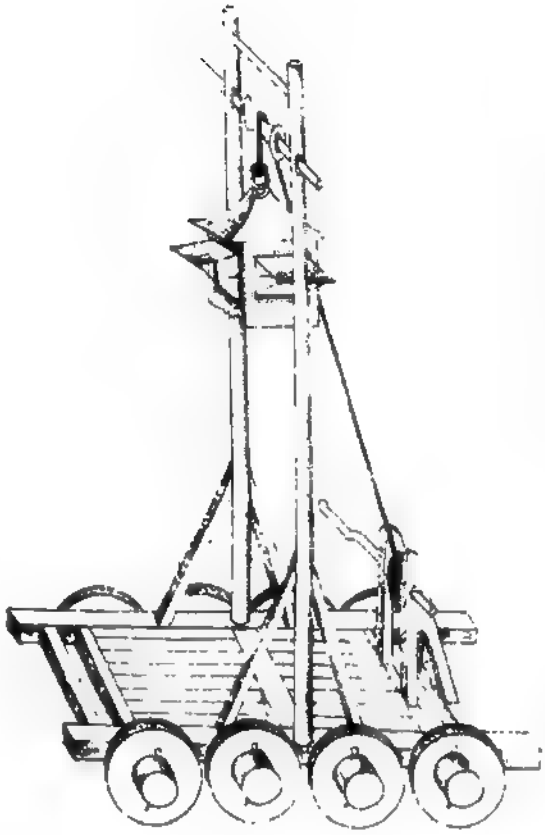
ASSAULT WEAPONS

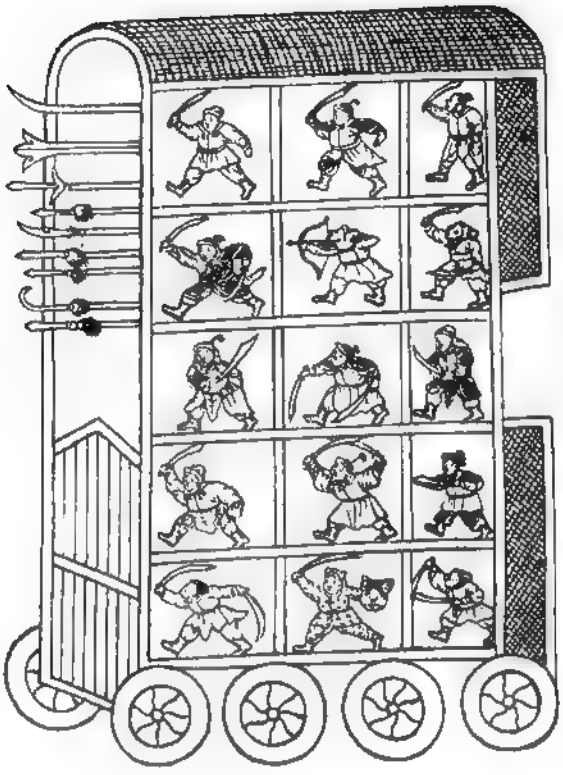
Siege Towers

Siege towers were an important feature of siege warfare in both the Far East and Europe, and can be usefully classified as static or movable towers. Static towers tended to be erected by both attackers and defenders when it was expected that a siege was to be of a long duration and siege lines were established, and such towers are frequently noted in illustrations.



Japanese static siege towers built rapidly from rough timbers in a framework of decreasing dimensions are used to provide high platforms from which archers can operate.





ABOVE LEFT **A nest cart, one of several varieties of Chinese observation vehicles. The observer would be stationed in the box, which could be hauled up and down.**

ABOVE RIGHT **A very stylised Chinese drawing of a mobile siege tower laden with troops, the machine known in Europe as a belfry. It is by no means certain whether such multi-storey versions actually existed.**

Static siege towers were used as observation posts where no high ground existed nearby. They inevitably attracted the heaviest fire from a defender's artillery and, at Nagashino in 1575, a crude observation tower raised overnight outside the castle by the Takeda only lasted a few hours after dawn broke and the new target was spotted. In a print of the siege of Takamatsu in Japan in 1582, the engagement won by Toyotomi Hideyoshi by diverting a river to flood the castle, a very prominent static siege tower is shown being used as an observation post. Japanese illustrations also show rough and ready observation towers made by the ingenious method of a pyramid of notched logs that gradually decrease in size until the platform was reached. Some pictures show several archers firing from such platforms into a defended position.

The movable siege tower was another commonplace of siege warfare. In the West, it usually appears as the 'belfry', the classic siege tower rolled up to a castle's walls, but in China there were also varieties used primarily for observation. The 'nest cart' is described as follows:

'Plant a tall pole on an eight wheel cart. Above the pole, place a pulley wheel and raise a box made of wooden planks that stops at the top of the pole. This is used to peer into the city. The planked box is four feet square and five feet high and has 12 holes arranged in the four sides. The cart can advance or retreat round the city walls and be positioned in a camp to provide a view into the distance.'

Various illustrations show a type of observation box with windows that was slung between two vertical poles rather than on one, and secured to a

windlass, implying that the observer was hauled up into the air inside his post. An alternative description is of a pole 45 feet high, like the mast of a ship, with horizontal projections that enabled an observer to climb up and enter the box. Both varieties appear in the Japanese literature as well.

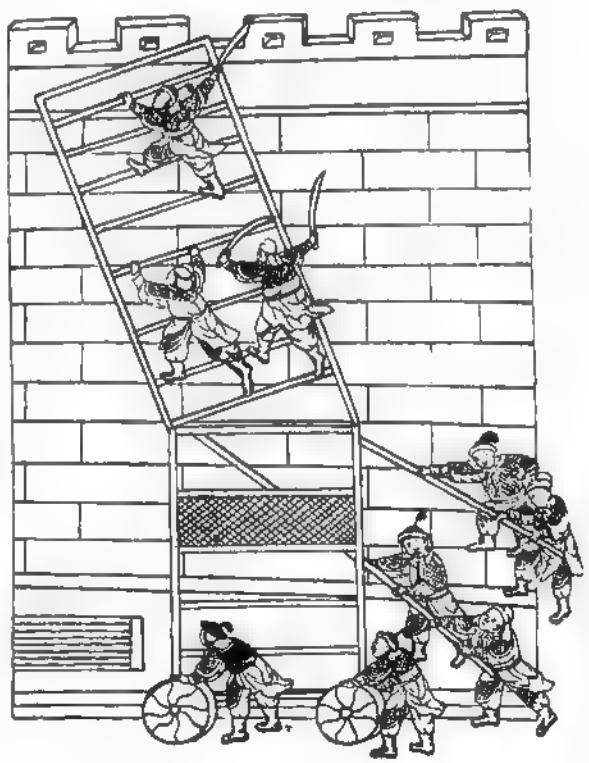
As for the Chinese version of the 'belfry', illustrations range from simple openwork towers with a platform for attackers only at the top, to an elaborate five-storey monster pushed forward by men stationed inside at ground level. The soldiers in the upper four storeys carry bows, swords and spears, and long spears project from the front of the vehicle, but the sheer weight of them makes the design every bit as unlikely as the fanciful multi-storey belfries of Europe. Japanese illustrations are much more modest, and Japanese siege towers bear a remarkable resemblance to the huge carts that still appear in Japanese festivals to this day. In Takayama in central Japan, for example, huge wooden towers on massive wheels are dragged and pushed through the streets while musicians and puppeteers entertain the crowds from on high, and in Kyoto's annual Gion Festival similar carts are hauled along by 50 men on each rope. The traditional design of Japanese castles, however, whereby the stone base of the castle had a wide and pronounced slope, meant that vertical siege towers were of little use in an assault, so their employment is almost exclusively noted for providing only a movable observation post or firing platform.

Cloud Ladders

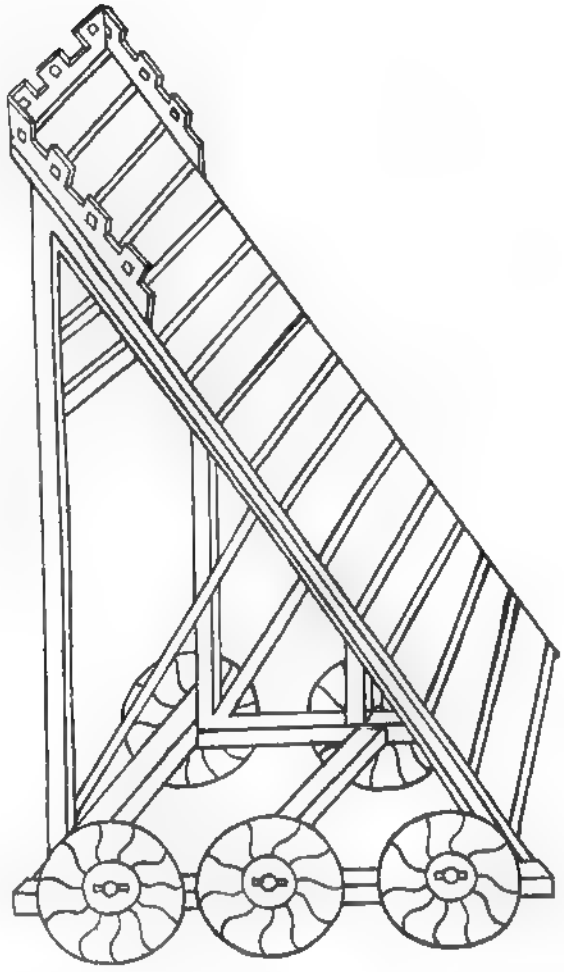
There was, however, one variety of Chinese siege tower that went some way towards overcoming the Japanese problem. This was the hinged 'cloud ladder', whereby a right-angled, triangular frame with a ladder on its hypotenuse was wheeled up to a castle wall, and an additional ladder was then swung out across the remaining gap. 'Flying ladders' or 'flying bridges' are alternative expressions used in the literature. The Chinese cloud ladder is particularly associated with the legendary military engineer Gong Lupan, a man so famous that even the compiler of the *Taiheiki*, Japan's great chronicle of the wars of the fourteenth century, had heard of him:

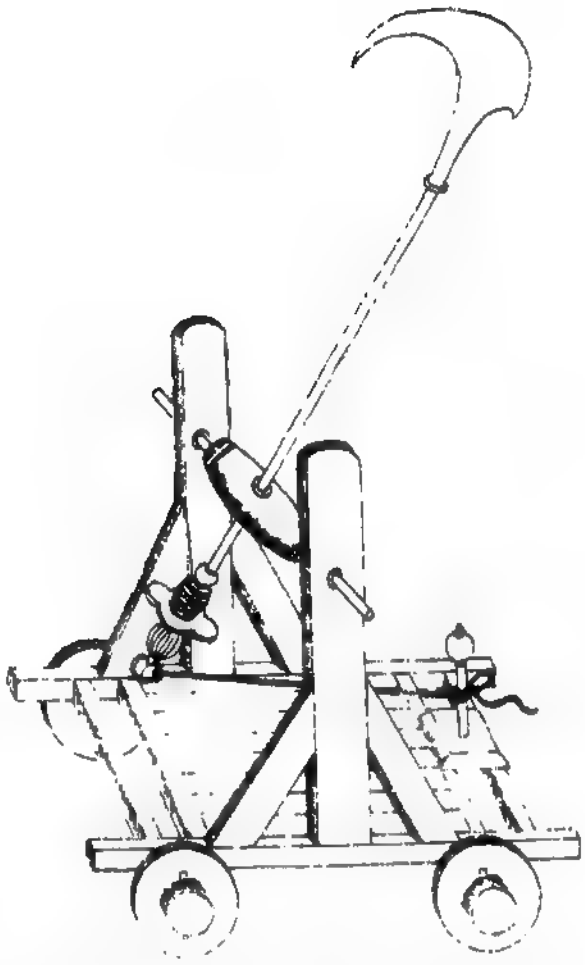
"'Let us lay down a bridge over the deep chasm between our camp and the enemy's castle, that we may enter the castle.' They summoned five hundred carpenters from the capital, gathered together timbers six, seven, ten and eleven inches thick, and made a bridge five yards wide and more than sixty yards long. When the bridge was made they tied on two or three thousand great ropes and wound them up with a pulley, so that the bridge fell on top of the castle's cliff. How skilfully it was done! Even such must have been the cloud ladder of Lupan!'

This Japanese version seems to have differed from the conventional cloud ladder in that it apparently had no wheels, but the operating principle was the same.



A stylised drawing of a cloud ladder, that nevertheless shows very well the principle of operation, whereby long poles (and also ropes) were used to flip over the hinged upper section to make contact with the defender's wall.





ABOVE LEFT **A simple wheeled ladder with no hinged section. This would just be pushed up against the wall to provide a more secure access than a scaling ladder.**

ABOVE RIGHT **A hook cart, a wheeled vehicle with an iron hook on the end of an arm that swung down like the upper section of a cloud ladder. Teams of men or oxen would then attempt to pull the wall down.**

The original Chinese cloud ladder, as described by Mo Zi, was mounted on four wheels, the rear wheels high and spoked and the front wheels low and solid, which would have made steering easier. At the appropriate distance from the walls, the vehicle would stop and the upper ladder would be folded down. This could be done by means of a counterweight with a rope that passed round a high pulley, which would have been very vulnerable to damage. The folding ladder on the later version associated with the Song dynasty was raised more simply by pulling from behind on ropes passed under the machine, with long poles helping the ladder on its way in the initial stages of raising. Smaller cloud ladders were of open design, but larger and stronger versions had a compartment built under the lower ladder to hold soldiers, who would give covering fire from crossbows while the machine was pushed up to the wall.

Cloud ladders were used by each of the three military cultures covered in these volumes. One of the best illustrations of a cloud ladder in action is Japanese, and appears in the *Ehon Taikoki*, a work based on the life of Hideyoshi, which shows one being used by Japanese troops in the attack upon Chinju castle in Korea in 1593 (see page 47). The forward ladder is fitted with hooks to allow it to grapple on to the parapet at the top of the wall and give stability while the soldiers cross

under fire. In this case, the machine is being attacked by hurling burning torches on to it, a sensible means of defence also recorded during a Chinese siege that took place 1,700 years earlier.

Hook Carts

Certain illustrations exist in the Chinese literature that appear to represent cloud ladders, but on closer inspection the hinged ladder section has been replaced by a hook on a long arm. This was the 'hook cart', and its purpose was quite different from that of the cloud ladder. Rather than allow men to climb into the castle, the hooks or claws bit into the top of the wall so that a part of it could be pulled down to make access easier for the cloud ladders and other climbing devices:

'The hook carts join the fray and nine oxen hauling each cart turn and heave, bellowing like thunder, and furiously smash the tower and overturn the parapets . . Then the flying ladders ... are rolled forward into the breaches so that the attackers can swarm into the city.'

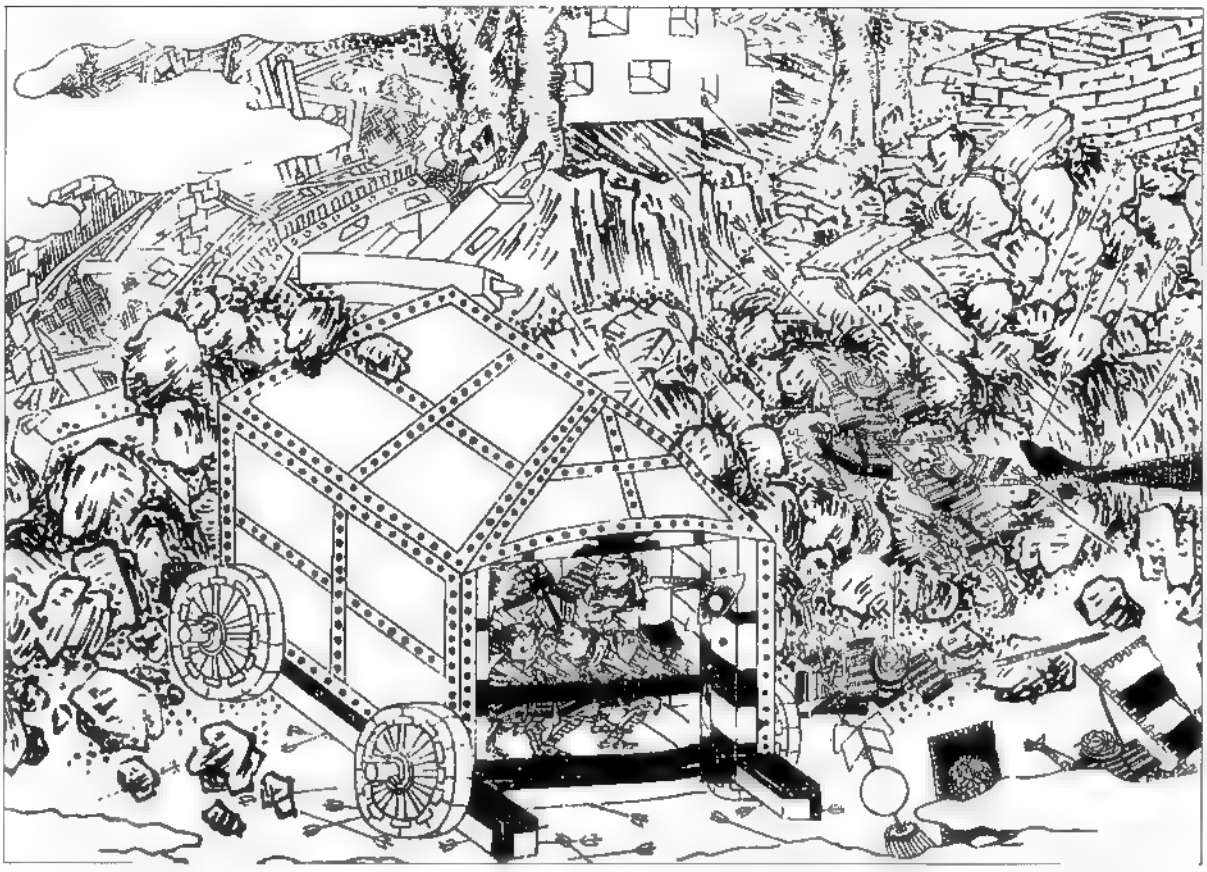
During one siege in 451, the defenders of the town countered the hook carts by tying ropes on to the hooks and pulling against them so that the force against the wall was balanced. During the night, some brave soldiers climbed up on to the walls and cut through the besiegers' ropes, leaving the hooks behind. In a later siege in 549, however, the attacking general brought up hook carts said to be 100 feet high, and when the oxen pulled, the walls gave way. A dramatic account of hooks occurs in an eyewitness description of the siege by the Ming of the Japanese garrison at Ulsan in 1598. 'They would put a large hook up on the wall and fifty or even a hundred men would take hold of the attached rope to pull the wall down,' wrote the author of *Matsu Monogatari* in some amazement. 'When this happened we fired on them from the side, but out of fifty men five or ten still hung on and pulled to the end. It has to be said that they are extremely brave warriors.'

Assault Wagons

Another way of bringing down a wall was to undermine it at ground level by levering out key stones so that a collapse would occur. This was not an activity that defenders would be likely to ignore, so protection was provided by some form of covered wagon that was wheeled up to the walls, and under the roof of which the attackers laboured. If the city was moated, the first requirement was to fill in the moat, and the 'tanks' would be pushed forward over the ramp. From the Tang dynasty:

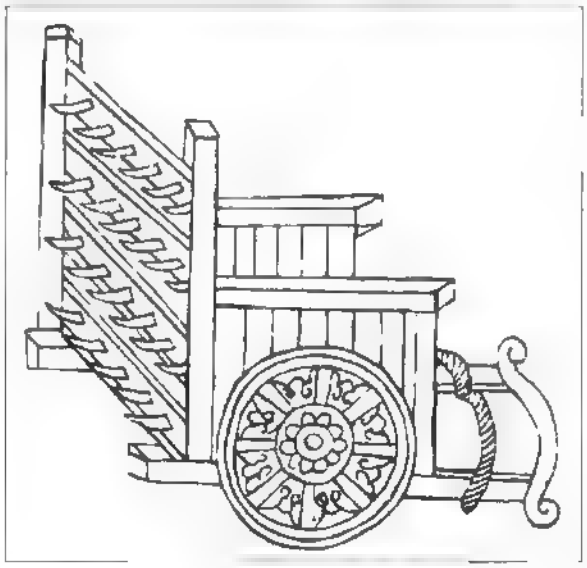
'Make a spine above with rope and cover it with rhinoceros hide. Below, it holds ten men When the moat is filled in, they push it straight underneath the walls, and can attack and excavate them. It is a machine which metal, wood and fire and stone missiles cannot affect.'

In 548, hundreds of simple 'wooden donkeys' carts like these, with sharp-edged roofs, were used to attack the town that is now modern Nanjing, but they were bombarded by rocks fired from trebuchets or just dropped by hand. The defenders also used the incendiary 'pheasant-tail torches' described in Volume 1. It was an attack by fire that caused the



BELOW **A knife cart for blocking up a gate. This could be used either by attackers or defenders when a gateway was breached.**

abandonment of the first attempt to take Chinju castle in Korea in 1593 using similar wagons. The Japanese called them *kikkosha* (tortoise wagons) and their invention was credited to Kato Kiyomasa. The Japanese returned the following day with new kikkosha that had green hides added to their roofs as a precaution against fire, and in spite of fierce bombardment from rocks, enough time was gained to dig out foundation stones and cause a large enough breach for a successful infantry assault.



Another form of assault vehicle was the 'knife cart', pushed forward by a team of besiegers to fill the gap made by a breach in a wall or a gate, an operation that could have been as usefully carried out by the defenders. During the Mongol siege of Taiyuan in Shanxi province in 1218, we are told that the Jin commander blocked up the gates with wagons, which may have included knife carts.

Battering Rams

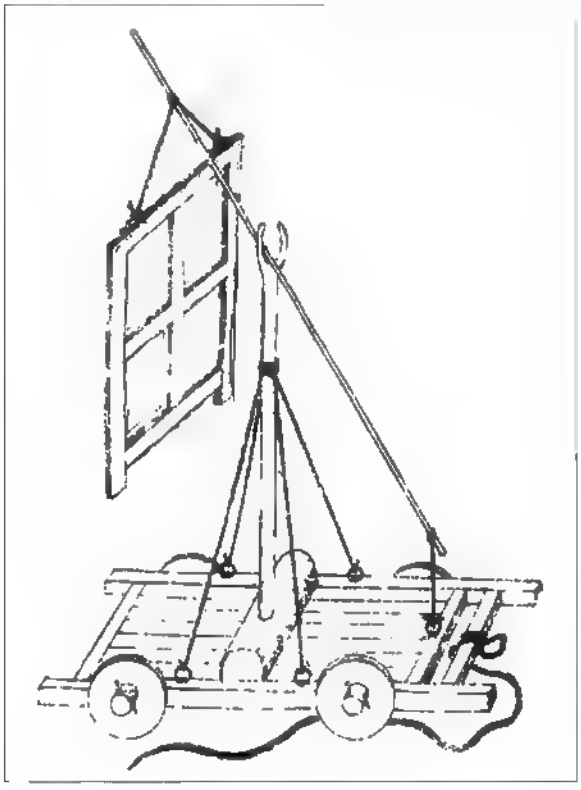
Chinese battering rams were fierce-looking devices with an iron-headed ram, like a huge spike swung from a cross piece, and were used as often from walls against cloud ladders as they were to break down a gate. During the siege of Sach'on in

LEFT **The use of 'kikkosha', the Japanese version of the Chinese 'wooden donkey' at the siege of Chinju in 1593. The illustration shows clearly how stones have been levered out from the wall, causing a collapse.**

RIGHT **A Chinese battering ram in action at the siege of the Japanese fort of Sach'on in Korea in 1598. This is a remarkable combination of modern technology, the cannon, being combined with a very ancient Chinese siege machine.**

1598, the Ming army brought up a ram against the gate of the Japanese-held fortress, and helped the device on its way to success by a cannon mounted just below the ram. The gun was fired at the gate at point blank range, and then the ram broke through. All that stopped a Chinese victory was a sally by the Japanese garrison and a direct hit, possibly from an incendiary bomb fired by a traction trebuchet, on to the store of powder for the cannon.

BELOW **A reconstruction of a Japanese mobile shield of sloping wooden planks at the Ise Sengoku Jidai Mura.**



Mobile Shields

Other machines provided cover for gunners and assault parties. The ones most commonly encountered in both China and Japan were mobile wooden shields with small openings for firing. Mobile shields made from solid planking appear in illustrations of the Manchu armies. Alternative designs made use of the absorbent properties of green bamboo, and consisted of bamboo bundles on a wheeled frame. A larger and more elaborate shield could be hung from a pivoted arm, and was controlled from behind by an operator so as to give protection in any direction to an attacking group. These were used in both Japan and China.

The most sustained encounter between China and Japan involving the use of assault vehicle siege weapons occurred during the battle of Sunch'on in 1598, the last conflict of the Korean War. While Admiral Yi's famous turtle ships maintained an offshore bombardment, the Ming army on land pushed forward several of the devices described above against Sunch'on castle. Realising that the

A wooden screen suspended from a pivot on a wheeled cart. The arm was operated by a team, who used it to provide immediate defence for soldiers on a cloud ladder or similar siege machine.

Chinese were putting much of their faith into these lumbering machines, the defending commander, Konishi Yukinaga, led a desperate assault in classic samurai style before the siege engines were finally in place. The operators were killed and the machines were burned, leading to the abandonment of the operation.

SIEGE WEAPONS FOR MINING

As well as assaulting city walls at their tops and their bases, complex mining techniques existed which allowed positions to be attacked from underground. The purpose of mining in siegecraft was twofold. First, it could be used to undermine the foundations of a wall or tower in a more thorough fashion than was possible by use of the tortoise wagons. Wooden props were then placed to support the excavated section, and when a sufficiently large cavity had been hollowed out, the supports were burned away and the wall collapsed. This was a technique used to good effect in Japan by Toyotomi Hideyoshi during the siege of Kameyama in 1583. In later years, the simple fire would be augmented by a gunpowder explosion. Second, the tunnel created by mining could be used to provide access for a surprise attack into a defended city, an example of which is the Japanese siege of Itami in 1574. The Takeda family made good use of miners from the gold mines of Kai province, and at the siege

of Noda in 1573 their miners drained away the castle's moat, thus depriving the garrison of their defence and their drinking water supply.

The Chinese developed several siege machines to provide protection to miners while they went about their business. The first, the 'wooden ox', was little more than a sturdier version of the wooden donkey and tortoise wagon described above, and did similar service, covering the approach to a mine just as these machines covered an operation at the base of a wall. The miners would go down into their excavations through the base of the wooden ox. The nearer to an enemy's lines it was placed, the shorter the tunnel needed. However, its presence not only announced that a tunnel was being dug, but attracted very heavy fire. For this reason, it became the practice to do one of two things, the first of which was to make the wooden ox into an assault vehicle. Known in its final version under the Song dynasty as a 'head cart', the machine was pushed forward to the start of the mine, protected by movable shields to the front, and with a crossbowman firing through a hole on the roof. Two long ropes were attached to the rear of the cart that reached to a windlass safely within the attacker's siege lines. The cart could then be rapidly hauled back to safety should the occasion demand it.

The alternative, which advertised the presence of a mine in no uncertain terms, was for the cart to be left in its forward position and a gallery constructed behind it as far as one's own lines, the above-ground passage being built in stages as the machine advanced. This meant that miners could move forwards and earth could be brought back without disturbance. An ingenious variation replaced the above-ground gallery by a wheeled cart that was hauled to and fro by means of windlasses and ropes. Excavated earth was taken back in it and more labourers could be brought up.

Of equal interest to these techniques for protecting mining operation are the machines used by a defender to detect mines, but the basic technique, stressed in all the military manuals, was by careful observation of the siege lines. Was there evidence of removed earth being dumped, for example, or was there a disturbance in a moat? In addition, a series of wells could be dug within the walls to house listening devices, which consisted of large earthenware jars whose mouths were covered with fresh rawhide. Someone with acute hearing would hold a jar deep underground and listen for any sound. Once the depth and direction of an enemy mine had been ascertained, a countermine could be dug. The Mongol besiegers of the Xixia fortress of Shazhou in 1224 dug a mine, but the defenders countermined it and burned them out.

The Mohist writings go into great detail about countermining techniques, which included blowing poisonous gas into an enemy mine. To do this, kilns were built underground and a mixture of wood and artemisia was burned. Bellows drove the resulting noxious mixture down the enemy mine. If time permitted, an elaborate system of earthenware pipes was laid as the countermine progressed, and when the enemy mine was broken into, a wooden shield was hurriedly erected through which the pipes were thrust and the poison pumped while guards kept the enemy at bay with spears. This was another siege technique brought to a peak under the Song, who blew the poisonous gas along the countermine galleys using fans.

COLOUR PLATES COMMENTARY

A: SOFT-CASED AND IRON-CASED BOMBS AND ROCKETS AGAINST THE MONGOLS AT KAIFENG, CHINA, 1232

Having captured Kaifeng from the Song in 1126, the Jin were forced to defend it against the Mongols in 1232, and once again this historic city was to see the employment of the latest in siege weapons. Gunpowder was now well established, and in this plate we see this vital substance being used for its explosive properties rather than as an aid to incendiarism. We are standing with the Jin defenders on the wall and looking back down into the city itself, where a traction trebuchet team operating a 'crouching tiger' trebuchet are about to launch a iron-cased thunder crash bomb (a fragmentation bomb) against the Mongols outside. There is also considerable activity on the ramparts as a flying crow with magic fire rocket goes whizzing past the Jin soldiers' heads. One defender is throwing down a ceramic ten thousand enemies bomb in its protective wooden casing, while his comrade swings the rope of a bee swarm bomb around his head as its fuse burns.

B: WHEELED ROCKET LAUNCHERS AT HAENGJU, KOREA, 1593

Multiple-launch vehicles for iron-tipped rockets or for rocket arrows were a feature of siege warfare both in Ming China and in contemporary Korea. Here we see two versions of the Korean *hwach'a* blasting the advancing Japanese as they march confidently forward to attack Haengju sansong (mountain castle) in 1593. Haengju consisted of earthworks strengthened by wood and some stone, and provided an excellent environment for the use of these weapons against a military culture that placed a great reliance on mass assaults. Haengju was defended by Korea's ablest general, Kwon Yul, who timed the operation of the hwach'a very carefully, and gained a considerable victory over the Japanese.

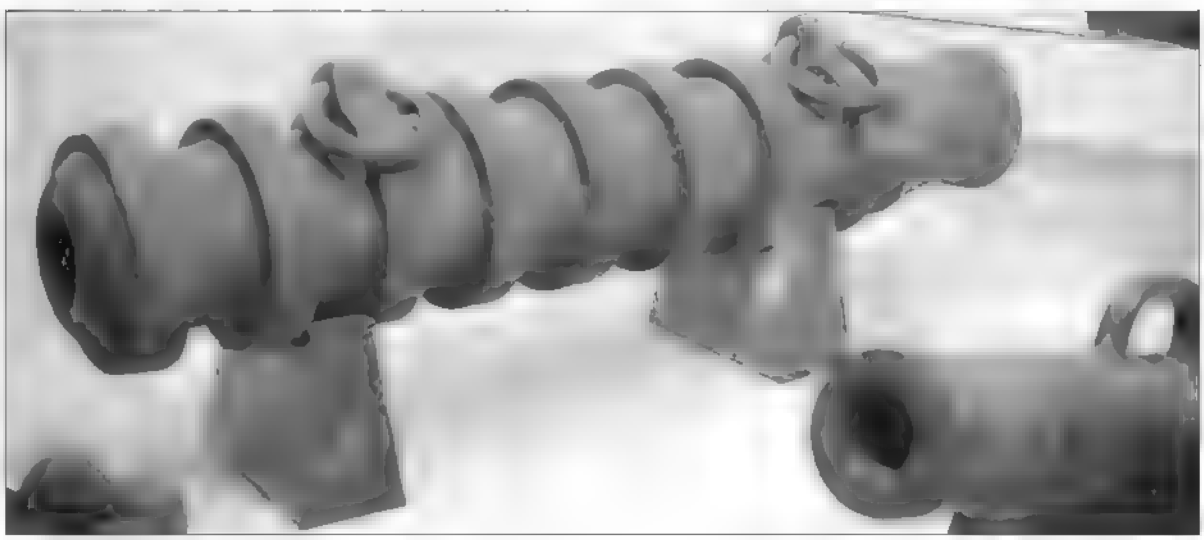
C: MING CHINESE SIEGE CANNON ON THE GREAT WALL OF CHINA, 1629

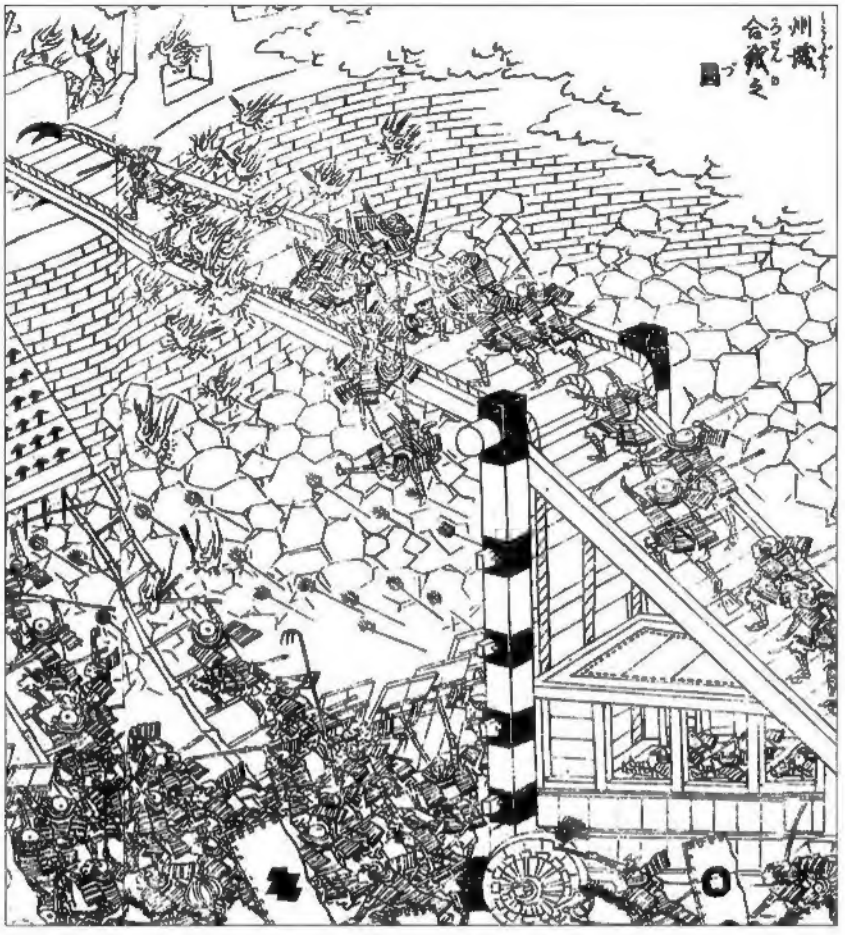
The Great Wall of China gives the appearance of being the peak of defensive architecture in the Far East, but during the last decades of Ming rule the advancing Manchus carried out several raids against it and broke through on some occasions. Here, a Ming Chinese great general cannon, the most popular make of native Chinese cannon, fires a warning shot from the parapet of the Great Wall against a raid by Manchu bannermen under Nurhachi's son, Abahai. They have cavalry as well as infantry, and a number of mobile shields made out of stout wooden planks to protect their arquebus men. They are wearing armour of a distinctive colour and design that is also found on the flag that identifies Abahai's banner unit. The great general cannon is a large-calibre model, and has been mounted on a simple wooden carriage

D: CLOUD LADDER AGAINST ANTI-PERSONNEL WEAPONS AT KAIFENG, CHINA, 1126

We return to the epic siege of Kaifeng by the Jin in 1126 for this plate, which shows a cutaway view of the most developed form of cloud ladder. Underneath the ladder itself is a compartment filled with Jin crossbowmen. While they provide cover, the hinged upper ladder disgorges assault troops on to the walls of Kaifeng, where they are met by various anti-personnel weapons. A wolf's tooth striking board crashes down upon them, and a brave defender risks the arrows to swing a thunderstick, effectively a giant mace, at the attackers. The insert panels show the sequence of operation of a cloud ladder. It is first pushed forward in the closed position, then two men lift the end of the hinged ladder section up to the point where the ropes can take over. These ropes are pulled and, if the estimate of distance is correct, the hooks on the cloud ladder will engage precisely with the parapet of the wall.

The 'great general cannon', the most popular version of native Ming Chinese cannon which existed in a number of different sizes.





The use of a cloud ladder by the Japanese at the siege of the Korean town of Chinju in 1593. Although much out of scale, it shows very well how cloud ladders worked, and the use of incendiary brands as a defence against them.

E: EUROPEAN CANNON AND FIRE ARROWS AGAINST A CASTLE GATE AT OTSU, JAPAN, 1600

No cannon cast in Japan could compare with the quality of European models, and Tokugawa Ieyasu made good use of his connections with English and Dutch traders to obtain cannon prior to the Sekigahara campaign in 1600. In this plate, we see the attack on Otsu castle. It was held for the Tokugawa by Kyogoku Takatsugu, and eventually surrendered after negotiation, but by this time the Tokugawa had triumphed at the battle of Sekigahara, so the victory at Otsu was irrelevant, and had merely kept some key Ishida supporters away from the main action. A European cannon, obtained from a ship and still on its naval carriage, is being used by Tachibana Muneshige to smash an inner gate. Instead of using cannonballs, the ammunition is a wooden fire arrow fitted with a barbed iron head that will bury itself into the wood of the gate. Two men hold on to the ropes by which the cannon will be hauled back after its recoil. The gun team is protected from the defenders' arquebus fire by massive bundles of green bamboo. The insert panel shows the details of a fire arrow and an alternative, exploding version.

F: MOBILE MORTAR AND THUNDER CRASH BOMBS AT KYONGJU, KOREA, 1593

The Koreans developed the combination of mortar and thunder crash bomb to its highest point of efficiency. Here we are standing outside Kyongju, a Korean town occupied by the Japanese invading force, on a brightly moonlit night in the late summer of 1593. A Korean mortar on a mobile carriage is about to give the garrison a surprise. The delayed-action fuse has been timed for the bomb to explode just after it hits the ground. Nearby, other Korean gunners under a senior officer assemble a different form of mortar that comes in two pieces, and prepare further thunder crash bombs.

G: MINING AND COUNTERMINING MACHINERY AT KAIFENG, CHINA, 1126

In the upper section of this plate, the Jin siege of Kaifeng in 1126 is helped along by mining. A heavy wooden head cart or 'wooden donkey' has been pushed up against the wall of Kaifeng to cover the entrance to the mine, but the attackers are by no means just passive victims of stones and rocks from the wall, and are firing back with a crossbow and hurling grenades. Concealed safely within the head cart, a soldier hauls on the winch that slowly pulls towards the walls the other cart in which waste soil has been taken back to the Jin lines. Meanwhile, in the lower section, we see the Song using very ancient countermining measures and equipment. These include a listening device made from skin stretched over a drum. The final vignette shows what happens when an enemy mine is located. The defenders blow poisonous smoke down the passage towards the attacker.

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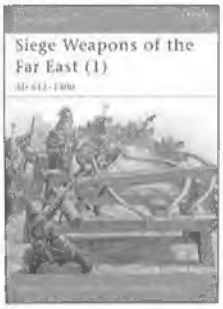

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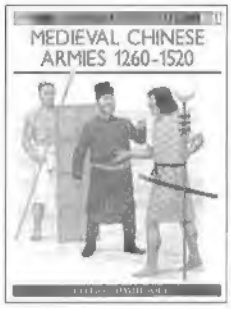

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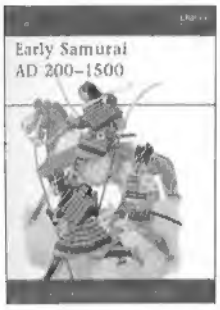

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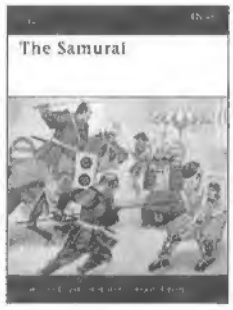

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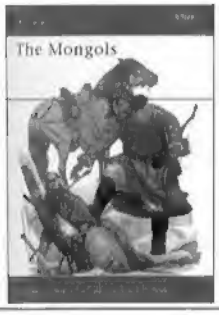

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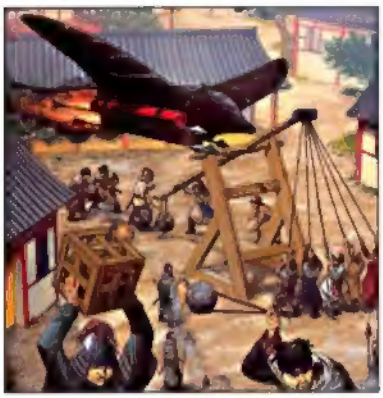

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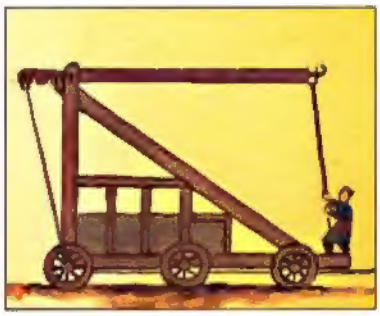

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